AGRICULTURAL ENGINEERING

Published by the AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Executive Office of the Society: Saint Joseph, Michigan.

ARNOLD P. YERKES, *President* RAYMOND OLNEY, *Secretary-Treasurer*

VOLUME 19 MARCH 1938 NUMBER 3

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Published monthly by the American Society of Agricultural Engineers. Publication office at Benton Harbor, Michigan. Editorial and advertising departments at the executive office of the Society, St. Joseph, Michigan . . . . Price $3.00 a year, 30 cents a copy; to members $2.00 a year, 20 cents a copy. Postage to countries to which second-class rates do not apply, $1.00 additional . . . . The Society is not responsible for statements and opinions contained in papers published in this journal; they represent the views of the individuals to whom they are credited and are not binding on the Society as a whole . . . . Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921 . . . .
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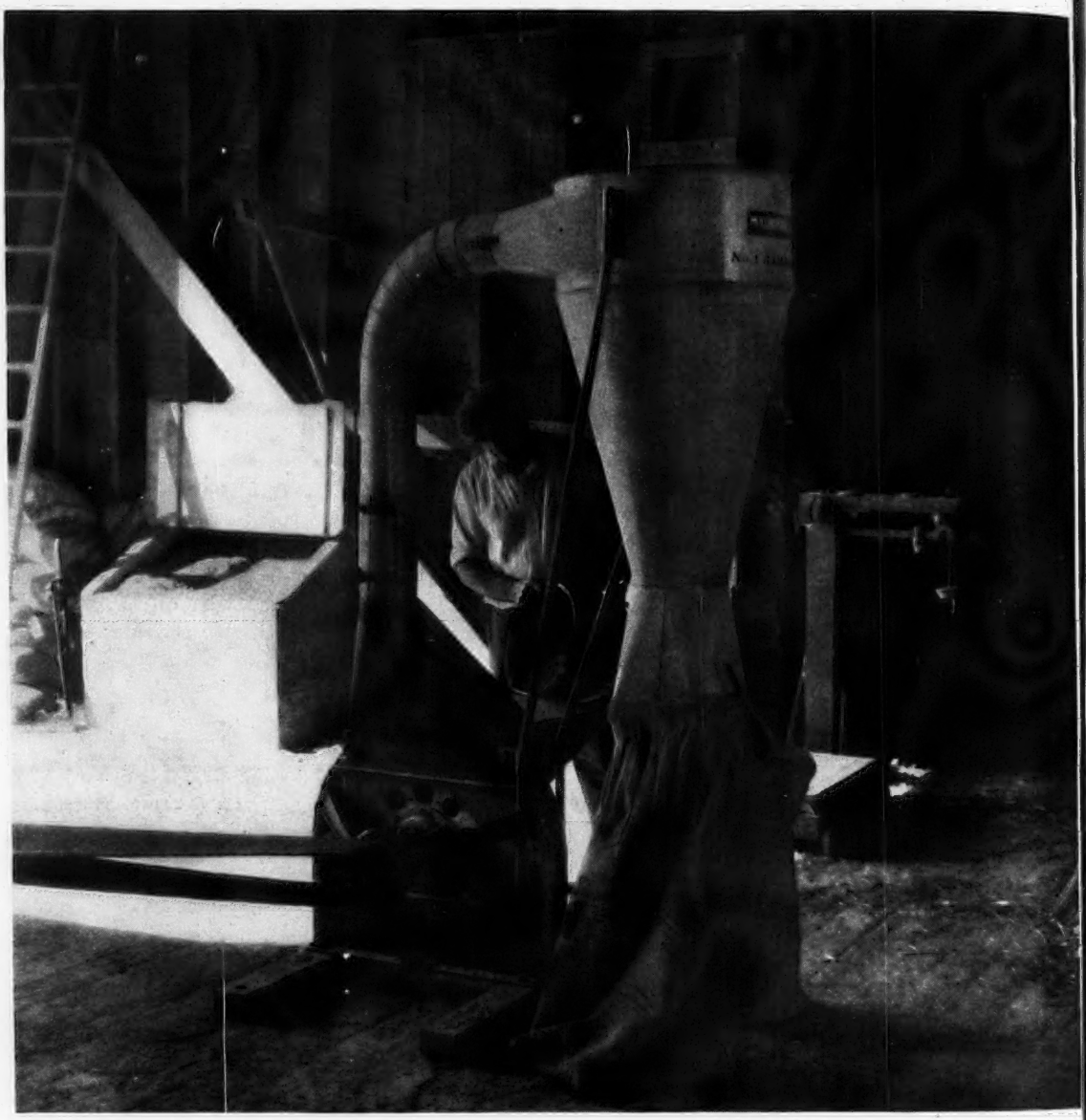

Farm Product Processing

BETWEEN the sure poor living of self-sufficient farming and the insecure speculative existence of the cash crop specialist lies a happy medium position of opportunity for farming with satisfactory efficiency, uniformity of income, and security. This opportunity is for increasing the range of the farmer's productive service in connection with any one or more specific commodities, by processing—using farm labor and capital to improve the condition of the primary commodity for sale or for further use on the farm.

Feed grinding is a mechanical processing operation which aids in feed handling and in biological processing into products of higher market value. Crop drying may improve quality and decrease waste. Refrigeration lessens deterioration. Specific farm processing operations might include cleaning, drying, grading, sorting, separating, grinding, pressing, concentrating, dissolving, fermenting, mixing, preserving, packaging, and others.

For purposes of agricultural engineering development it may be considered that any product or combination of products of any farm may be put and maintained in any desired condition by the farmer, to meet any market demand, so long as the process does not involve extreme hazards or intricate technical control; and so long as the equipment and operating costs are kept in line with the volume handled and the advantage gained.

AGRICULTURAL ENGINEERING

VOL 19, NO 3 EDITORIALS MARCH 1938

An Economic Parallel

SUBSTANTIAL economic support for the engineering viewpoint on production efficiency has been provided by Dr. Harold G. Moulton, president of The Brookings Institution. In an address, entitled "Technological Development in Relation to Economics," delivered before the recent winter convention of the American Institute of Electrical Engineers, Dr. Moulton discussed real wages, among other things.

"An increase of wage rates relatively to prices," he said, "depends fundamentally upon increasing the efficiency of production. Only thus will the means be available with which to pay higher real wages and provide more goods and services. Accordingly, there must be a constant acceleration of technical advances, improved management, increased labor efficiency, and so forth. Any practices or policies that tend to work in this direction may be regarded as economically sound, and any that tend to work in the opposite direction must be pronounced economically unsound."

Amplifying this statement, he pointed out that when any factor in production—labor, capital, or management—attempts to increase its return without a corresponding increase in its contribution to production, it merely upsets the working relationship between the various factors. In the resulting readjustment the ratios of return resume their previous proportions; the higher price levels all along the line are, in fact, inflation; and respective returns for production are apt to be diminished along with total demand for the goods and services in question.

Farming, although it often combines labor, capital, and management in the same persons, involves the same considerations in its competition with urban industries for its share of the national income. We believe the most general agricultural engineering viewpoint on farm income, and one worthy of consideration by farmers and legislators, is that farmers can materially increase their real income only by increasing their production efficiency; and that this increase in real income will give them more material satisfaction and sound prosperity than any fixed proportion of a variable national income, if, as, and when it could be assigned to them.

Dissatisfaction in Engineering Minds

IN ENGINEERING education, as in many other things, the grass on the other side of the fence appears greener, according to reported indications of a recent engineering meeting[1]. Men with ample technical education feel the need of cultural development and vice versa.

The need of variety in the mental diet is real and recognized. It is necessary to the solution of many-sided practical problems, and important engineering problems are characteristically many-sided, with practical objectives.

Dissatisfaction of the type noted may be taken as a healthy sign of original, creative imaginations impatient with the difficulty of marshalling guiding and supporting facts from the libraries of existing knowledge.

Engineering minds want to do creative work. They cannot do it by letting the imagination run riot without facts as tools and materials. Neither can they produce much if an excessive amount of their time is devoted to collecting information, to the exclusion of imaginative exercise.

It was pointed out in the same meeting that more courses on this and that will not satisfy the intellectual appetites of engineers. In fact, we believe that the engineers dissatisfied with their education in one way or another do not want their mental appetites satiated. They want the intellectual fences broken down; the factual grass made more accessible in all related fields. They want to speed up the routine work of looking up information; to get more accurate information on more sides of their problems in less time; and to have more time and understanding to apply to creative thought.

Progress of engineering education in this direction might turn these engineering minds to the more profitable dissatisfaction with self which leads to increased utilization of inherent individual capacities.

[1]A meeting of the Ohio Society of Professional Engineers, in Columbus, Ferbuary 9 to 11, 1938, reported in "Engineering Experiment Station News."

A Business View on Farming

WHERE enlightened business stands in relation to modern farming methods and related equipment was indicated by H. B. Walker in opening the annual farm machinery conference at Davis, California. He pointed out that, in a meeting looking toward sound programs for agricultural development, 38 prominent citizens of San Luis Obispo County arrived at conclusions worth noting as representative of business thought. The group included farmers, merchants, bankers, teachers, utility men, and others, but excluded representatives of the farm equipment industry.

Without reference to the equipment with which it should be done, they recommended such practices as chopping of feed, adequate weed control, turning under straw and stubble, deep chiseling on contours, definite control methods for gullies, and a contour strip system to be worked out for grain farming. They further recommended that small producers expand their operations where possible to the most economical scale, and decried the subdivision of land into units too small to support a farm family, and too large for a laborer's homestead.

These recommendations may be taken as considered good for the county because they were considered good for the individual farmers thereof. They are recognition of biologically and socially desirable farming practices made economically sound and possible by modern farm equipment.

Agricultural Hydrology

WATER behavior near the point of precipitation, particularly in upstream agricultural areas, has finally received legal recognition as a factor in flood control, as pointed out in the paper by D. S. Myer elsewhere in this issue.

This is a logical response to two prime considerations developed by years of work on the part of civil, hydraulic, and agricultural engineers. Their work has shown that comparatively few large watersheds have any one or even a few strategic points at which measures can be applied effectively and economically to protect the entire area from damaging floods. The alternative indicated is control all along the line from the point of precipitation to the watershed outlet. Water behavior has been found to vary materially with concentration and many other influences. Flow data for large streams are of little value in calculating flow characteristics of small streams, surface runoff at the point of precipitation, or ground water movement. Agricultural hydrology is a field in itself. Basic information thereon is essential to adequate upstream flood control measures.

Water supply, power, sewage disposal, navigation, and flood control projects involving levees, dams, floodways, and other major engineering structures have necessitated the development of hydraulics of large waters. The application of auxiliary measures for flood control at and near the widespread sources of flood waters is a comparatively new concept, with little background of applicable hydraulic information.

Who should carry on research in agricultural hydrology? Everyone, we believe, who is in a position to make a substantial contribution thereto. In considering who these may be, we invite attention to the fact that more is involved than water as a potential source of floods; more than hydrology on a smaller, more intricate scale. As water in large rivers is a factor in power and navigation, water on farms is an agency of biologic production, a controlling factor in farm crops and farm operations.

The only hope of agricultural hydrology contributing to flood control is that its applications likewise contribute to farm programs of production. Water will be held in and on upland farms, and released gradually, not by police power in the interest of the lowlands, but by and in the immediate self-interest of the upland farmers. Few of them are suffering from excess water, but most of them are paying for poorly controlled water. In addition to dealing with the behavior and flow of water in and on farm lands, agricultural hydrology must be closely related to use and requirements of water by farm crops.

These considerations should give agricultural engineering services of federal and state agencies a logical interest in agricultural hydrology and in the new opportunities offered for research in this field.

Engineering Farm Types

TO THE fund of challenging concepts of agricultural engineering work and opportunities expressed by various agricultural engineers within the past year or so, and noted in these pages, we welcome the opportunity to add those of W. C. Krueger, as expressed in his brief address published elsewhere in this issue.

His thoughts on the angle of engineering approach to farm problems bear repetition and study. "No longer" he says, "can we extend our engineering program by the old divisions of farm power and machinery, farm structures, soil conservation, rural electrification, water supply and sanitation. Rather must we apply agricultural engineering in terms of agricultural adjustments in dairy, poultry, fruit, vegetable, and grain farming. There will be duplication and overlapping of the program among these farm classes, but this approach offers a better way to tie our work in with that of the other specialists in the agricultural field."

This does not necessarily mean that research and development of physical agencies and methods needs realignment for agricultural purposes. They are grouped naturally according to techniques of research and development. Let the gathering of basic data continue, and the resulting improvement of power sources, field equipment, building materials, building design, electrical operating equipment, soil conservation methods and what not, but go the whole way and work with other specialists to give farmers a better basis for selecting, organizing, and using these improved methods and equipment units to increase their overall efficiency in their respective types of farming. Individual unit efficiency remains an academic matter until it is applied to increase the net or overall economic efficiency of a production enterprise.

Herbs in Chemurgy

WRITING of "The Pharmaceutical Farmer," Arthur D. Little, Inc., urge in their "Industrial Bulletin" for January, that the medicinal, insecticidal, and flavor-making herbs should not be neglected in the present trend toward agricultural products as sources of raw materials for industry. They point out that "the present vogue for pure concentrates calls not only for synthetic materials from the chemical factories, but also for the essential ingredients of many natural products, under the name 'isolates'."

Peppermint and spearmint are given as examples of drug plants which have proven profitable to farmers in certain parts of the United States, largely by virtue of their being capable of machine methods of production. Pyrethrum flowers are still imported in large quantities, but agricultural engineers are working on the limiting factor in domestic production, harvesting machinery. The possibility that raising the crop in this country would economically justify the extraction of pyrethrins from parts of the plant other than the flowers, is mentioned. That would materially change the harvesting problem.

Digitalis, ephedra, pinkroot, angelica, lavender, larkspur, goldenseal, and Canada snakeroot are mentioned as other herbs with market and commercial production possibilities in the United States. Machinery for low-cost production is the limiting factor in all cases. The minor crops for which there is limited demand will not offer an attractive market for special machines, but might provide an additional outlet for some machines already in production, while helping to broaden agriculture's field of service.

A New Farm Transportation Unit

By F. W. Duffee

PROBABLY 70 to 75 per cent of all farm hauling in the Middle West is done within a radius of 10 mi of the farmstead, in which case a tractor traveling at a speed of 10 to 20 mph can do most of the road hauling as well as the farm hauling. For the occasional longer haul, it would probably be more economical to hire a commercial trucker than for the farmer to try to maintain his own truck, with the resulting expense of license, insurance, and upkeep, involved. This refers to trucks of one-ton capacity or more and not to cut-down passenger cars which serve a useful purpose on many farms.

The two-wheeled or semitractor unit which we have developed is not new in general principle, but it does represent some new features which we believe make it better adapted to the farm hauling problem.

Capacity. It has seemed to us that the most popular size would be one of two tons net capacity, although other sizes will be in demand. Any ordinary farm tractor could readily pull this size, although we have found that a tractor of slightly over 20 belt horsepower could not pull the unit in high gear (15 mph) up grades found on our main trunk highways with a net load of approximately two tons.

Type of Bed. A universal type of bed seems desirable; a flat platform, hay-rack type is used. This is necessary for hauling hay, cornstalks, and grain bundles, and when equipped with side boards it can be used also for hauling loose grain, ear corn, bagged material, and machinery. When equipped with a rack, livestock can be hauled.

Size of Platform. Farm hauling is usually bulky, and this, coupled with the added power of the tractor as compared to a team of horses, led us to adopt a platform 7 ft 11 in wide by 16 ft long. This was arrived at partly from an analysis of the present hayrack used on horse-drawn wagons, which racks are usually about 7 ft wide by 14 ft long. It is our opinion that the tractor trailer should be larger to use the larger power unit more efficiently.

Semitrailer. The trailer is a two-wheeled or semitrailer type; the axle is located 7 ft from the rear end and 9 ft from the front end. The drawbar extends 4 ft beyond the end of the chassis.

This type seems much better adapted to tractor hauling than does the four-wheel type. It is much easier to manipulate, trails better than a four-wheel type with less tendency to weave, and it can be easily backed into any position, a necessary operation for farm hauling and one that is next to impossible with the four-wheel trailer.

Another feature which seems to be an advantage is that part of the load is carried on the tractor, which increases its traction and also increases the total capacity for a given set of trailer tires. This type is easily adapted to the tilting platform feature which facilitates the loading and unloading of machinery. The large flat platform will accommodate any ordinary farm machine. We have hauled grain binders, hay loaders, side-delivery rakes, and automobiles, all of which were loaded by means of the tilting

Presented before the Power and Machinery Division, at the fall meeting of the American Society of Agricultural Engineers, at Chicago, Ill., November 30, 1937.

Author: Professor and head of the agricultural engineering department, University of Wisconsin. Mem. ASAE.

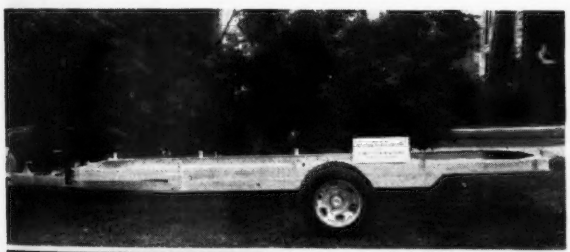

Fig. 1 (Upper left) The all-steel, electrically welded chassis has the axle attached 7 ft from the rear and 9 ft from the front. The drawbar is hinged at "A" to permit tilting the bed for loading heavy machinery. Fig. 2 (Lower left) The dual wheels equipped with 6.00–16 or 6.50–16 (standard auto or implement tires) give large ground contact on soft ground, keep the bed low, and at pressures of 28 to 32 lb cushion the load without the use of springs. The hubs have roller bearings and may be equipped with brakes. Fig. 3 (Below) The stock rack may be removed leaving the box bed for hauling grain, corn, etc., or the complete rack and box may be removed, leaving the flat platform for hauling hay or similar loads

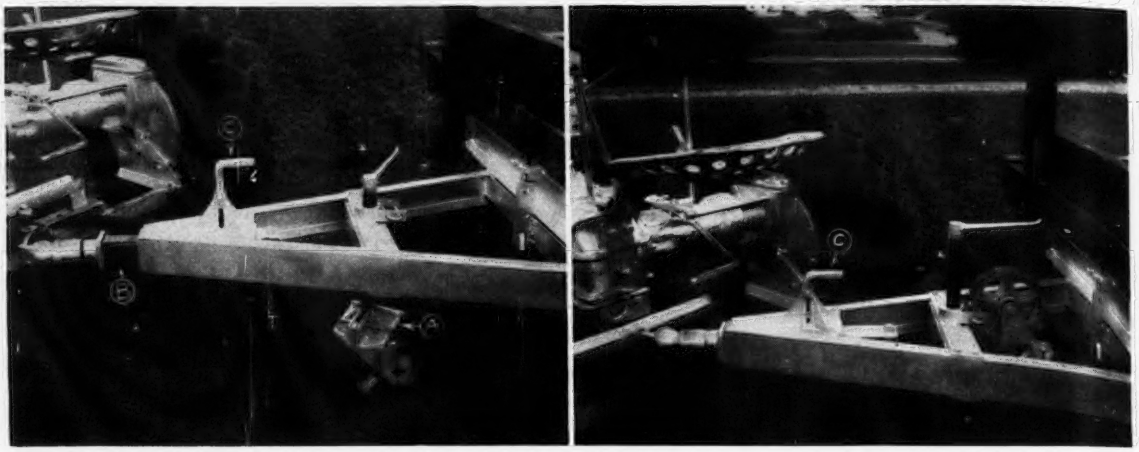

FIG. 4 (LEFT) THE SCREW JACK AND CASTER WHEEL SUPPORTS THE FRONT END WHEN THE TRAILER IS UNHITCHED FROM THE TRACTOR. NOTE THE HINGE CONNECTION "A" BETWEEN THE SCREW AND CASTER WHEEL. THE TELESCOPING TONGUE PARTIALLY EXTENDED ("B") IS TO PROVIDE EASY HITCHING UP. "C" IS THE LOCK PIN FOR THE TELESCOPING TONGUE. FIG. 5 (RIGHT) THE CASTER WHEEL IS FOLDED UP. THE TELESCOPING HITCH IS CLOSED AND THE LOCKING PIN "C' DOWN IN PLACE

platform. In one case, six small buildings 10x12x7 ft were hauled a distance of 35 mi. One building was hauled each trip, requiring about 2½ to 3 hr with the load and only about 2 hr empty.

The Chassis. The chassis is all steel, employing stock material throughout, and so designed that most of the pieces are cut from stock to suitable length and welded together. The chassis is electrically welded, and when finished is one solid piece of steel, with the exception of the drawbar.

Assuming that the unit is correctly designed for the loads imposed, and barring mishaps, the chassis should last indefinitely. To be specific, 50 years should be a reasonable life expectancy.

Most of the features described from here on are the new ones used in this unit.

Wheels and Tires. A 16x4.50-in dual wheel is used. This carries a 6.00–16 or 6.50–16-in tire, the common automobile size and type. The original draft of this unit was developed about one year before such a wheel was available. The common truck dual wheel is 20 in in diameter. Duals of 16-in size and type were adopted for the following reasons:

1 Lower first cost for the same load-carrying capacity.

2 The 6.00 or 6.50–16, four-ply balloon tire inflated to 28 lb pressure gives a satisfactory cushioning to the load without the use of springs, thus reducing cost.

3 Duals at a pressure of 28 lb provide a large ground contact surface; that is, they will hold up better on soft ground.

4 The tires on the family automobile may be transferred to the trailer when they become unsafe for high-speed driving.

5 And last but not least, the lesser overall diameter of these tires as compared to others that might be used permits a lower platform. On our unit the platform is approximately 32 in above the ground, and has no tire wells.

A possible disadvantage of the dual tire is that when traveling over rough ground, all of the load on one side may occasionally be thrown onto one tire.

The tread for the outside tires is 76 in. The dual wheel tracks nicely behind a general-purpose tractor.

This trailer has proved the most desirable unit our farm help has used for loading hay. The absence of springs and the wide-tread dual wheels, together with steady forward motion, provides ideal conditions for loading with a loader. Also the low platform of large size facilitates hauling large loads. I should say that it would be almost impossible to tip the unit over on side hills.

TABLE 1. TOTAL LOAD-CARRYING CAPACITY OF TIRES
(Maximum speed, 20 mph—Trailing vehicle)

Size of tire	Inflation Pressure: 4-ply tires, 28 lb		6-ply tires, 40 lb	
	One tire, lb	Four tires, lb	One tire, lb	Four tires, lb
6.00—16	1240	4960	1520	6080
6.50—16	1410	5640	1740	6960
7.00—16	1620	6480	1990	7960
7.50—16	1670	6680	2110*	8440

*36 lb inflation pressure.

NOTE: Dual wheels for 7.00–16 and 7.50–16 are not in production but the dual described above could be modified easily to use this size.

The Hitch. The inability to hitch up and unhitch quickly and easily is probably one of the greatest disadvantages of the semitrailer, and unless this can be done easily, even when the trailer is loaded, it probably will not prove popular. Therefore, we have given a great deal of attention to this particular feature.

The hitch point on the tractor must be rigid; any type of swinging drawbar, which may be left unlocked may cause a "jack knife" when going down hill, with a resultant wreck. Locking the tractor drawbar must not be left to the judgment or carefulness of the operator. In two cases we have developed an additional *fixed* drawbar attachment on the tractor somewhat above and ahead of the regular drawbar, so that neither interferes with the other. On light tractors care must be exercised in locating this tractor drawbar close enough to the rear axle of the tractor to avoid galloping of the front end, or under extreme conditions, actual lifting of the front end.

Making contact between the tractor and the trailer requires bringing two points together. This means movement in three directions—up and down, sideways, and lengthwise. It is obviously difficult, if not impossible, to back the tractor up to the *(Continued on page 106)*

Needed Improvements in Potato Machines

By M. G. Huber

AS IN all other farm production enterprises, machinery is playing a major role in potato production. Planting, cultivating, spraying to control insects and disease, digging, harvesting, storing, and finally, in grading and transportation to market—each operation has its specific type of machine to take care of the various operations involved.

Of all the potato equipment, planters are about the best developed potato machines in use today. Generally speaking, some of the newer planters will put the fertilizer in the desired place, and will cover shallow or deep. However, some manufacturers still persist in putting small disks on the front furrow openers for fertilizer placement. Small disks do not do a satisfactory job where the planting is rather deep. The size of disk furrow opener is important to insure sufficient depth of penetration.

Some of the manufacturers still advertise that their machine will put fertilizer above, on a level with, or below the seed piece. In practice, a planter cannot deposit the fertilizer above or on a level with the seed piece and not disturb the fertilizer bands. If deep covering is practiced, the covering disks are apt to disturb the fertilizer bands. For mechanical reasons, the fertilizer to be undisturbed, must be placed slightly below the seed piece. Recommendations to Maine growers suggest that the fertilizer bands should be about 5½ in apart on the inside, allowing 1½ in for the size of the seed piece, and leaving 2 in between the seed piece and the inside of the fertilizer band.

Fertilizer spouts, on some planters, are dropping the fertilizer too far behind the furrow opening disks, thus allowing the soil to drop back in the furrow, before the fertilizer reaches the ground. Some of the fertilizer spouts are so large that, on a hillside, the distance the fertilizer is placed from the seed piece varies as much as one inch, compared with level planting. The spouts should be as small as possible at the opening, extend down into the furrow as far as it is practical, and held securely in place.

Spacing between seed pieces should be easily and readily changed. Seed growers are now planting as close as 6 in. A suggested series of spacings for Maine conditions would be 6, 7½, 9, and 12 in. The fertilizer gate should have markers or an adjusting lever, so that the operator can easily change the rates of application; or if out of adjustment readily bring it back to its original setting.

Seed furrow openers could be improved on some planters, so that the seed piece will not roll when striking the ground. One method of accomplishing this is by cutting a piece from the bottom of each wing of the furrow opener shoe, about 2 to 3 in up from the bottom and approximately the same length or a little longer horizontally, permitting dirt to roll in on either side of the potato just as it strikes the bottom of the furrow and prevent its rolling. This is particularly important where planting is done on an upgrade.

The potato sprayer still seems to be the best "goat getter" of all potato machines. However, with adequate care and a careful operator, it will do a satisfactory job. All the new sprayers require regular replacement of parts. Since this is common to all machines, improvements might be made along this line. In some of our sprayer repair schools, it was necessary to use a hammer and chisel to remove some valve seats. Even the tools supplied for this purpose failed to do the trick. There still is quite a margin between the cost of repairs for different makes of sprayers. Although it is not a policy to recommend the buying of any particular make, the buyer's attention may be called to the cost of overhauling, and the difficulty of doing repair jobs. Another common fault on sprayers is the use of too small piping on the boom, resulting in too much pressure loss.

Development of tractor-mounted sprayers is definitely lagging. One manufacturer is putting a tractor-mounted sprayer on the market. A statement made by one of their larger dealers was that last year's production was largely an experiment. One of our larger potato growers, not satisfied with the cumbersome tractor-drawn equipment, built six sprayers mounted on all-purpose tractors. He apparently has worked up a nice business, because latest reports were that he had at least fifty orders in advance for next year.

Of all potato machines, probably the greatest improvement can be made in diggers. I am not in a position to say just how much research work has been done along this line. Some new diggers have come on the market in the last several years. However, they still do not meet the needs for operating in fields having varied soil conditions, nor for reducing bruising to a minimum.

According to studies made by the Maine Agricultural Experiment Station, the tuber injury resulting from digging runs as high as 17 per cent. It is one of the most serious defects in the market quality of potatoes. The extension services of some of the eastern agricultural colleges are making various recommendations as to padding, equipping, and operating the diggers to reduce bruising to a minimum. The most commonly used digger in Maine is the continuous elevator type. This type only will be discussed.

One of the greatest difficulties is found in eliminating the whip and sag from the rear section of the elevator bed. The removal of some rods, the use of extra rollers, and using an outside drive chain have been recommended. Naturally we must expect the operator to use some discretion and judgment in the operation of any piece of equipment. However, it seems that some things like padding or redesigning the elevator rods to remove the sharp corners, or putting on a rear drive chain that will take the load when slipping occurs over the main drive sprockets, should be a relatively simple matter. Probably two drive chains will fulfill this requirement. Some of the power diggers have been designed to keep the elevator tight in the rear of the bed.

One of the most difficult and common digging problems in some areas is in fields having a variation in the soil, requiring a small amount of agitation in some spots and severe agitation in others. A potato digger equipped with a variable agitation device on all elevator agitator sprockets, easily adjusted from the operator's seat, would satisfy these requirements. It has been suggested that such a device should provide a simultaneous and equivalent change for each agitator and have a range from zero agitation to maximum by merely shifting a lever.

Presented before the North Atlantic Section of the American Society of Agricultural Engineers, at Toronto, Canada, October 12, 1937.

Author: Extension specialist in agricultural engineering, University of Maine. Mem. ASAE.

I am not familiar with all methods of harvesting in other sections, but according to our experiment station records, picking, harvesting, and storing cause 47 per cent of the bruising. A potato harvester similar to that under experimentation at the Pennsylvania State College should have some possibilities. Combining picking and harvesting into one operation should reduce bruises, at the same time resulting in labor and time saving.

The picking of potatoes by hand represents a considerable part of the harvesting costs. Comparing potato harvesting with small grains it can be seen that there is room for development and improvement. It does not seem logical that potatoes dug should be placed back on the ground to be picked by hand, particularly in a country that has the highest development in mechanized agriculture.

There is also need for a good vine lifter.

An altogether too common practice in Maine is to run the rows up and down the slopes. Soil erosion practices recommend planting on the contour. It seems that most of the potato machines are top-heavy and tend to slide downhill. A solution must eventually be found.

Graders seem to do a satisfactory job if handled properly. No recent studies have been reported on bruises resulting from some of the newer graders. Probably most of the bruising results where the potatoes are fed to the grader and where they are bagged. The operators can do much in reducing bruising in these operations.

Much of our effort in the extension service must be in education of the operators of equipment, because better planting and spraying, and much of the reduction in bruising, are under the control of the operator. In this brief discussion these suggestions are made because the assistance of the manufacturers is needed to iron out mechanical difficulties. Then we can devote our efforts and time toward better operation and care, thus hoping to bring about a more marketable product in the potato industry.

A New Farm Transportation Unit

(Continued from page 104)

trailer and hit the hitch point exactly; therefore, the trailer hitch should be so designed to provide this accommodation.

The trailer drawbar is fitted with a screw jack which provides a support for the front end when unhitched and also provides the vertical adjustment necessary when hitching up.

The jack is fitted with a ball bearing caster wheel 8 in in diameter and 2¼ in wide which permits shifting the front end of the trailer sideways so that the trailer hitch matches the tractor drawbar. This wheel also permits moving the trailer when it is unhitched from the tractor. On a hard surface a fair load can be moved in this way.

The trailer drawbar is equipped with a telescoping hitch to provide the lengthwise adjustment. This is self-locking and self-tightening when backed up to the closed position.

In order that the operation of this important feature be made clearer, I will explain how it works when hitching to the tractor. The driver backs up the tractor so that the hitch point on the tractor is within 4 or 5 in of the hitch point on the trailer. He gets off the tractor, jacks up the trailer to the correct height, extends the telescoping hitch the necessary amount, pushes the trailer drawbar sideways until the two parts of the hitch meet, then closes the hitch. He then unscrews and folds the jack, gets on the tractor, and backs it up to close the telescoping hitch which automatically locks in place. The unit is then connected, ready to travel.

In actual practice this design is proving entirely satisfactory. With a two-ton load on the trailer, the tractor can be hitched up or unhitched in a minute or two.

The jack screw is 1½ in in diameter with a single ¼-in pitch thread, and is fitted with a 10-in crank, giving a theoretical mechanical advantage of 251:1. The caster wheel is attached to the screw by means of a hinge which permits folding the caster wheel up into the drawbar, out of the way.

Weight of the Trailer. The weights of the trailer with different equipment are given below:

Weight of chassis with front upright	1190	lb
Weight of unit with flat platform and uprights	1762	lb
Weight with 16-in box	1882	lb
Weight with stock rack	2147	lb
Weight on caster wheel (box and stock rack on)	420	lb
Weight on tractor (stock rack on)	400 ±	lb
Additional weight on tractor (assuming two-ton load evenly distributed)	307 ±	lb

The weight of the chassis may be reduced somewhat by the use of a built-up axle, and possibly 4-in channel iron may be used in the frame instead of 5-in.

The bed is made of wood. As a merchandise proposition, we believe the chassis should be factory made and the platform and bed built by the farmer. With this in mind, the platform and bed have been designed for wood construction. The box is approximately 7x15 ft inside, and may be any desired depth. Our trailer is 16 in deep and has a level-full capacity of 112 bu.

Brakes. Brakes may or may not be used, as desired or as required by state laws. No doubt all states will soon enact laws making brakes compulsory on such trailers that go on the highway, whether two-wheel or four-wheel.

(ACKNOWLEDGMENTS: The author wishes to express his thanks to the following companies who assisted in the design and construction of this farm tractor trailer: Budd Wheel Company, Eaton Axle Company, Gillette Rubber Company, Timken Roller Bearing Company, and Youngstown Sheet and Tube Company.)

An Extension Program for Helping Farmers to Make Electricity Practical

By D. G. Ebinger

WHETHER we are affiliated with colleges or universities actively engaged in disseminating rural electrification information, or whether we are interested in rural electrification from an operating utility standpoint, I believe our views are essentially the same.

We have devised various ways and means of promoting the practical use of electricity on the farm. An extension program which may work well in one section of the country may not necessarily be the answer for some other state or section. The perfect plan is, of course, the goal toward which we are all striving. I will use the rural electrification extension program of Michigan State College as a background, not because we think we have the answer, but because I prefer to deal with actual rather than theoretical examples.

In Michigan we have had a rural electrification extension program operative for about ten years. No doubt many of you are familiar with the demonstration truck and trailer which we used to carry the story of electricity to our rural population. In those days it was necessary for the extension specialist to promote rural line extensions, in addition to demonstrating the practical value of electricity on the farm. Today this is no longer necessary. The aggressive attitude of utilities, further stimulated by the activity of the REA has largely taken care of rural line extensions. The extension specialist in rural electrification of today has passed the pioneering stage of developing a program that will familiarize agriculture with rural electrification information. He is today faced with the problem of keeping pace with a fast moving program.

At the present time, in excess of 75,000 Michigan farms are enjoying the benefits derived from central station electric service. Some of these farms have been using electricity for a number of years, others have just recently received service, and there are also thousands of farms just about to connect to the high line. All of these groups are asking for answers to their electrical problems. Many are interested in wiring, others are concerned with the selection and proper use of fixtures and equipment, and still others desire information on new uses for electric power. To adequately cover all of these details we have incorporated in our rural electrification extension program a number of projects. I will elaborate on one or two of these.

POPULAR WIRING SCHOOL FEATURES PLANNING OF FARM WIRING SYSTEM

The farm wiring school has met with wide favor in our state because at the present time hundreds of farms are about to wire their buildings so that they can properly use electric service. Ordinarily these schools are from 1½ to 2½ hours in length. They are held in schoolhouses, town halls, or any other central location where interest runs high. No attempt is made in these meetings to make electrical contractors of the farmers. Mechanical details necessary to a good farm wiring program are not covered. It is my aim at these meetings to point out just what constitutes a good farm electrical distribution system so that the farmer will be able to intelligently aid his electrical contractor in laying out the farm wiring job to see that enough convenience outlets, switches, and fixtures are installed. The desirability of wiring for both 110 and 220-volt service is covered. It is stressed that large wire should be installed so that the farmer can take care of tomorrow's electrical uses, as well as the few lights and the one or two household conveniences that he is thinking of today. Recently eighteen of these meetings were conducted in one county which is to be served by a cooperative electric line.

Occasionally these schools are conducted on a little different basis. Sometimes the county agricultural agent feels that it is desirable to conduct an all-day meeting. In that event the morning session is devoted to a general discussion on farm wiring and some of the problems related to it. In the afternoon the prospective electric customers bring sketches showing the floor plans of their houses. We then consult with them on the basis of these plans to develop the type of wiring system which will prove most advantageous to them. This is followed by a general round-table discussion in which the important factors necessary for a proper and adequate farm wiring job are again pointed out. This type of school seems to work out very well and it is planned to hold this latter type of meeting generally during the coming year.

DEMONSTRATION FARMS SHOW ONLY ELECTRIFICATION OF NORMAL ENTERPRISES FOR EACH FARM

Another of our extension projects has to do with demonstration farms. It was felt that experience and data gained from working with one group of farmers was not well received by other farm groups. Even though they were living in the same state, they were separated by 200 or 300 miles. At the present time we are establishing four demonstration farms in as many counties to provide living examples in those respective communities.

These farms will in no sense of the word be model demonstration farms. No attempt is being made to completely electrify every farm operation. Rather, we are electrifying only those enterprises normally carried out on each farm. Arrangements have been made with various manufacturers wherein the farmer buys his own equipment at wholesale prices. Meters are being installed on these various pieces of equipment by the utility serving that area. The county agricultural agent is cooperating in the project. He is, through the press, suggesting that other farm folk in his county visit these demonstration farms and get the actual experience of their neighbors in using electricity for certain farm jobs.

One of our major projects has to do with what we call our two-day rural electrification school or show. These schools, covering a period of two days each, are sponsored through the cooperation of various agencies, including the county agricultural agent, the utility serving that particular area, the local implement, hardware and electrical deal-

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Presented before the Rural Electric Division at the fall meeting of the American Society of Agricultural Engineers, at Chicago, Ill., December 2, 1937.

Author: Rural electrification extension specialist, Michigan State College.

ers interested in merchandising farm electrical equipment, and the extension division of the state college.

To arrange the program and details for one of these two-day schools requires considerable time and effort on the part of all cooperators. A typical school shapes up about as follows: The county agricultural agent, after determining that such a school is necessary, selects a suitable location, usually in the heart of the area he is attempting to serve. The next step is to arrange an adequate program which will cover the use of electrical energy on the farm and in the farm home in such a way that the rural consumer of electricity can derive the most benefit. To accomplish this end, it is necessary that a display of electrical equipment adaptable to the farm and farm home be exhibited. It is the agricultural agent's organization that contacts the local dealers who normally serve the area covered by the school, and gets them to exhibit electrical equipment. The dealer installs this equipment in a space provided him for this purpose. Usually a representative of the exhibiting firm attends his own display for the purpose of answering questions that may pertain to his own particular brand. The selling of goods is not a part of this program. This is strictly an educational activity and one in which the dealer is glad to cooperate.

Household equipment, such as ranges, refrigerators, radios, washing machines, irons, water heaters and small appliances, together with the farm equipment including pumps, motors, feed grinders, milking machines, and cream separators, make up the display. Supplementary exhibits featuring the adaptation of electric power to home-made equipment such as feed mixers, grain elevators, hay hoists, and poultry house lighting and water heating equipment, is furnished by the agricultural engineering department of the state college.

Publicity for these schools is provided by the county agent who sends out news letters and invitations to people interested in farm electrification. These schools are set up entirely for rural folk. Additional publicity is furnished by the college, this material usually being sent directly to the local newspapers. In some instances the local publisher has devoted entire sections of his paper to a special rural electrification edition.

TWO-DAY SCHOOLS COVER ALL STAGES OF PROGRESS IN FARM ELECTRIFICATION

In presenting the program to rural people, it must be remembered that all stages in the development of farm electrification are represented. Thus these two-day schools are broken up into definitely arranged meetings.

On the first day there will be a wiring school for the men. The details covered are similar to those previously mentioned in connection with farm wiring schools. The need for adequate capacity in wire is emphasized. The desirability of properly located power and convenience outlets is stressed. The various wiring methods and materials are discussed. It is again not the intent of this meeting to teach farmers how to wire their own buildings, but its aim is to point out just what constitutes an adequate farm electrical distribution system.

While the men are attending the wiring school the ladies are attending a school on home economics. This is conducted by home economists furnished by the utility, cooperating with the home demonstration agent, an assistant of the county agricultural agent.

In the evening of the first day there is a discussion of rates and policies concerning farm line extensions. This portion of the program is usually handled by a representative of the utility. Then there is a home lighting school in which lighting requirements, lamps and fixtures, and the advantages of adequate lighting are discussed. This part of the program again is furnished by the utility. In closing the first day's meeting a sound picture depicting the uses of electricity on the farm is shown.

For the men there is an afternoon session on the second day, an electric motor and farm equipment school. In this meeting the proper type of electric motor, adaptable to the farm, is discussed. Demonstrations are conducted showing the limitations of certain types of motors. This is in the form of a test showing the difference in the power developed in corresponding sizes of the split-phase and the repulsion-induction motors. A demonstration of the farm equipment on display is conducted, together with a discussion concerning the uses and limitations of this equipment. The original investment necessary to procure the equipment, and its operating costs, are covered.

The ladies in the meantime are attending a cooking and home appliance school. During the evening of the second day there will again be sound pictures and if the crowd is largely a different one than attended the first evening's meeting the same film and lighting school will be repeated; otherwise, this will be varied.

EFFECTIVENESS OF TWO-DAY SCHOOLS

These schools, fourteen of which have been held during the past year, have been well received, the average attendance per school being approximately three hundred. These shows have enabled us to present to the rural users of electric energy a detailed program. They have enabled us to point out and prove that electric energy used in quantity will more than add its share to the profits of the farm. These schools have given us an opportunity to show that electricity is no longer a luxury, that it is now a decided necessity; that farmers who have electric service and use this low cost, efficient method of operation, have a decided advantage over their competitors who depend on more laborious and more costly methods of producing and processing their products.

The fourteen schools which have been held to date were largely experimental in nature. They were used as a means of testing a new educational method. The county agricultural agents who assisted in setting up and conducting these schools were well pleased with the results, and have requested that additional schools be conducted in their counties during the next year. Requests have also come from county agricultural agents who did not participate in the shows of the past, but have heard of the success of the venture. The two-day farm electrification school is now included as one of our regular extension projects.

The Michigan 4H farm electrification project has been definitely associated with our program for four years. The 4H rural electrification contest sponsored by one of the larger electrical manufacturing companies has added impetus to this program and it rightfully should, because youth is more receptive to new ideas; these so-called modern ideas are easily within their grasp and, too, the 4H club member of today is the farmer of tomorrow.

We have passed the pioneering stage of developing a program that will familiarize agriculture with rural electrification information. The work previously done by the utilities and cooperating agencies is now culminating in a correlated effort that, applied to an improved agriculture with greater purchasing power, has its reflection in increased energy uses. For the first time since the birth of rural electrification, agriculture is responding to its original promise of supporting it; and associated with this thought is one of still broader meaning, that rural electrification can help support agriculture.

A Small Diameter Feed Collector

By Olin M. Geer

THE DEMAND for something smaller, better in appearance, and at least as good in performance as feed collectors commonly used, constituted our reason for attempting to develop a new feed collector. Though our experiments and tests were not extensive, we nevertheless did quite a lot of research and testing, and think we have developed an efficient and effective collector which will do the work of a much larger conventional collector. In this work every effort was made to conform to the natural laws involved.

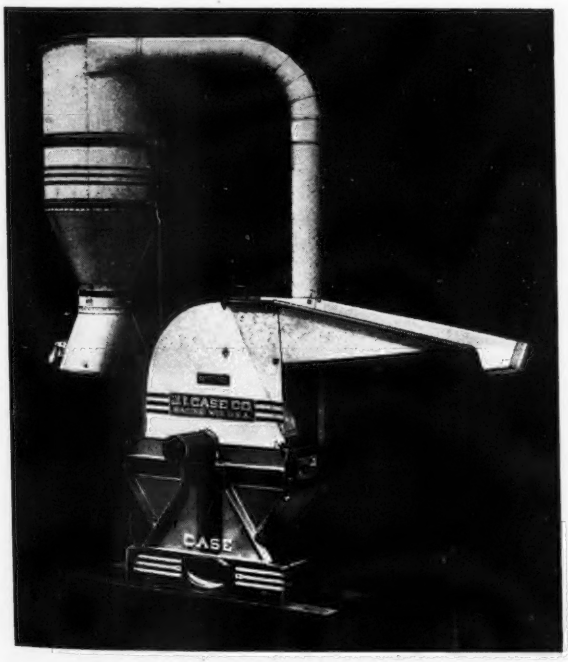
In addition to anticipated improvement to come from a smaller collector diameter, it seemed reasonable to suppose that functional improvement could also be made over the ordinary feed collectors, provided a true mental picture were made of the particle-laden air going on the ideal path in a collector shaped to induce a perfectly uniform cyclone. The laden air in this hypothetical cyclone would, from time of entry, thread downward at a uniform rate to a place somewhat below the chimney lower end, but not low enough to pick up collected particles, and, the particles having dropped out, make a smooth inward and upward turn to the chimney, and out, this inner part of the path becoming progressively steeper until, at the chimney outlet, it would be going upward on a straight, vertical line, having constantly decelerated from the time of its entry into the chimney to a mild breeze upon discharge. In such a hypothetical cyclone all the particles would severally move outwardly at their maximum uniform rates, depending on their masses and volumes, and on the air velocity. As the particles separated they would move around the wall downwardly toward the lower opening.

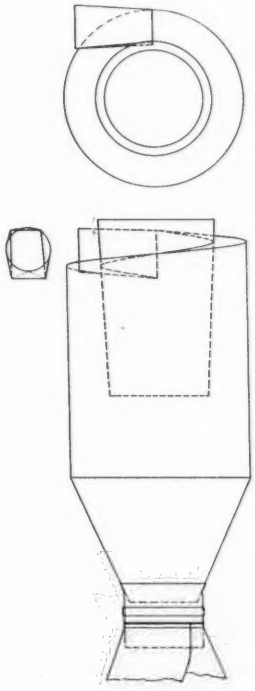
Author: Designing engineer, J. I. Case Co., Mem. ASAE.

In at least two respects it is impossible or impractical to make a collector that will induce such ideal conditions throughout. First, because air enters at one side, tending to make the cyclone wabble; second, because, under the most favorable conditions, it does not seem possible, without vanes or other mechanical means, to "persuade" the air to gently leave the chimney in a straight vertical path having no dead center. Side propulsion, coincident with one-side air entry, does not apparently cause serious disturbance. Any remedy, furthermore, would greatly complicate the collector and pipes, and would be of doubtful value. For that reason, and because it would be difficult or impossible to devise a double inlet that would not interfere with separation on the first turn, a remedy was never seriously considered. In every other respect it seems that the ideal was practically attained.

In the conventional type collector the less laden air at the end of the first turn and the consequent layer of collected particles either meet the fully laden entrant air, or they are diverted or partly diverted by a series of eddies. In any case, there is bound to occur a certain amount of remixing accompanied by eddying and a consequent drag upon the force of the blast. To overcome these troubles it was decided to "thread" the top sheet downward enough to compel the first turn to end just under its beginning.

While the threaded top adds materially to the effectiveness and efficiency of a collector, it neither sets up nor becomes a remedy for any critical conditions, and should be considered more remedial than functional. The chimney diameter and length, however, have functional relations with other collector parts; and whether the chimney is





(LEFT) HAMMER MILL WITH SMALL DIAMETER FEED COLLECTOR. (RIGHT) TOP AND SIDE VIEWS OF SMALL DIAMETER FEED COLLECTOR. THE AUTHOR SUGGESTS THAT CYCLONE FEED COLLECTORS PRESENT A RICH FIELD FOR FURTHER RESEARCH. THE STUDY REPORTED HERE REPRESENTS A COMMERCIAL ATTEMPT TO IMPROVE DESIGN BY APPLICATION OF KNOWN PRINCIPLES. ADDITIONAL RESEARCH MIGHT INCREASE KNOWLEDGE OF THE PRINCIPLES INVOLVED

tapered or not, and if so, how much, influences efficiency and effectiveness.

In view of the fact that certain coarse and fibrous materials are frequently handled, the collector opening at the bagging attachment must not be smaller than some figure previously determined by practice. This, in turn, determines the chimney diameter. A quiet opening at the bagging attachment is essential. If air blows out, dust comes with it, and if air is sucked in strongly, the material will tend to accumulate in the collector lower end and tend to be blown out, and also a burden of extra air will have to be handled. The optimum condition here would be from neutral to a very slight suction. This condition is determined by the chimney diameter, if straight, and principally by the smaller diameter, if tapered. The simple explanation is that chimney discharge air is still whirling, causing the outer portions of the chimney to carry all the air, and that a dead-to-a-negative center is thereby created. Roughly speaking, the diameter of the center area which would average neutral in direction should be found to be about the same in diameter as the opening at the bagging attachment. This so-called neutral core probably is of about the same diameter the length of a straight chimney, necking in at about the midpoint between the chimney lower end and the opening at the bagging attachment. Below this it should increase to its original diameter at the opening at the bagging attachment. A smaller neutral core here would mean that air is escaping through the opening, and a larger one that it is being drawn in. In other words, the pressure at this opening, whether positive or negative at the beginning, varies inversely as the chimney diameter. All these are deductions which, in most respects, have been borne out by experiments.

For a feed collector of a given diameter and with a given slope of lower section, the chimney length is dependent upon the collector length. Under these conditions the distance between the chimney lower end and the opening at the bagging attachment should be about the same for different collector lengths. In other words, the distance is that of the space required for the vortex to change its direction from downward to upward. When the distance allowed is too little, the collector lower end will be turbulent, and consequently formerly collected particles will be picked up and carried out at the chimney, and there will be irregular puffing and sucking at the bagging attachment, and even though the best chimney diameter should be obtained, collectible particles will continue to be carried out.

From the time air enters until it leaves the collector the natural tendency would be for it to expand and slow down. Due to the intimate association between the progressive turns of the air in the body of the collector, there is also a perhaps stronger tendency for all this body of air to whirl at the same rate. With these opposing tendencies in mind, imagine a downwardly expanding space as would occur in a straight-walled collector with a tapered chimney, large end up. Here we have introduced a condition which will tend to increase the number of turns the air will make per given distance downward. In any case, there will be room to spread inwardly, and that should somewhat check any tendency to spread downwardly. In this respect it therefore seems probable that a tapered chimney would add slightly to collector capacity. It also gives less discharge loss, and hence adds to the fan's handling ability. It is thought that in a tapered chimney the outgoing air, while slowing down in the chimney, tends further to spread by closing in on the neutral-to-negative center, thereby adding more to blast effectiveness, and also lessening or preventing the entry of air at the chimney center. A stream of air entering the chimney center would, of course, set up more air friction and add a further volume of air to burden the system, and, what is more serious, create a downblast which would disturb collection.

Since our requirements called for a small diameter collector, it was decided to begin with the smallest diameter in the bounds of reason. A 12-in straight chimney was chosen, and since 3 in was considered a minimum width of passageway between collector wall and chimney that would not choke up when handling coarse, fibrous material, the collector diameter chosen was 18 in. Were it not essential to have a relatively large and open delivery at the bagging attachment, this diameter would probably have been ample, or even more than necessary. Naturally, the larger this opening, the larger the neutral center should be. For this reason, and to facilitate manufacturing, a slightly larger diameter was decided upon.

The determination of collector length was made by telescoping the body. Several positions were tried. As the length was increased, collection improved visibly up to a certain point, but beyond this it was scarcely perceptible. We therefore chose the length where the collection curve would approach a straight, flat line. It is understood, of course, that when collector length is being determined, the chimney length must be varied accordingly.

Feed collector cyclone investigation surely would be a rich field for thorough academic exploration. It is hoped, therefore, that this has been presented in such a way as to provoke further investigation.

ACKNOWLEDGMENT: The author wishes to acknowledge valuable aid received from a paper entitled "Research on Cyclone Dust Collectors," by Louis C. Whiton, Jr., presented before a technical meeting of the Metropolitan Section of the American Society of Mechanical Engineers, New York, Feb. 18, 1932. Credit is given to C. A. Ocock (Charter ASAE), who took all Pitot tube readings. His survey with a Pitot tube in an early collector with a straight chimney enabled us to identify a serious disturbance in the collector lower end as one caused, at least in part, by an air blast coming in through the center of the chimney. Credit is also given for his aid in determining the proper distance between the chimney and collector lower ends.

FSA Develops All-Steel Farm Buildings

A GROUP of low-cost, all-steel prefabricated farm buildings, built by the Farm Security Administration in cooperation with a large southern steel company, near Greenbelt, Maryland, was formally opened for public inspection February 11.

It has been estimated that the entire group of buildings—including a five-room house, barn, smokehouse, poultry house, and sanitary privy—can be delivered unassembled for approximately $2,000.

The buildings were jointly designed by FSA engineers and steel company technicians, as part of the Farm Security Administration's program of developing inexpensive but adequate dwellings for low-income farm families, in cooperation with private industry.

In order to keep both initial costs and maintenance at a minimum, the farm structures have been built of prefabricated panels of galvanized copper-bearing steel, welded to light cold-rolled steel structural members.

A novel system of attaching the buildings to their foundations has been utilized. A bearing plate, welded to two hot-rolled channels, forms the supporting pier. The floors are carried on welded, built-up girders. Steel window sashes and built-up, flush-type doors were installed in their panels in the shops, thus reducing construction costs.

Soil Conservation Districts

By D. S. Myer

THERE is a great deal to be said about a new form of rural cooperation—the soil conservation districts which are now being organized in several parts of the country. They represent a new and enlarged attack on the problem of soil erosion. They bring up important questions of local administration and management. To illustrate the way in which they fit into the general picture of agriculture, it may be well to review how the U. S. Soil Conservation Service and other agencies are trying to meet the problem of erosion damage, and how soil conservation districts are designed to supplement these efforts.

Over a period of many generations farmers in this country and in foreign lands have developed, by a process of trial and error, a large number of methods and devices for controlling erosion and conserving water resources. In recent years agricultural scientists have tested these measures, worked out their relationships, and made some helpful improvements. Agricultural engineers have had no small part in the progress made to date. It is now rather generally agreed among authorities on the subject that erosion can be controlled effectively only by treating each parcel of land according to its inherent needs and adaptabilities.

Presented before the Soil and Water Conservation Division at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1, 1937.

Author: Chief of division of cooperative relations and planning, Soil Conservation Service, U. S. Department of Agriculture.

For example, steep or highly erodible land should generally be planted to a growth of trees or shrubs; intermediate areas should be maintained in permanent pasture or meadow; while crop production should be confined to those parts of the farm where erosion can be safely checked by the use of soil-conserving rotations, engineering devices, and proper methods of cultivation. The whole program should be designed to slow down the runoff of rainfall and promote its absorption by the soil. It should include a proper combination of agronomic measures and simple engineering structures, with approved methods of forestry and wildlife protection on those farms where woodlands and wildlife are economically important.

At the present time programs of this general type are being carried out in cooperation with the Soil Conservation Service by more than 50,000 farmers and ranchers whose lands are located within the boundaries of demonstration projects or in the vicinity of erosion control CCC camps. Each of these project and camp areas was selected to typify a broad surrounding agricultural region. Within each area soil conservation measures adaptable to the general region are installed and tested under representative conditions. Neighboring farmers and ranchers are invited to visit the treated areas and inspect the erosion control methods which may be applied, sometimes with modification, on their own lands.

The record of achievement under this program has been encouraging. On thousands of farms soil losses have been cut down, gullies stabilized, and moisture conserved. An indeterminate number of landholders have been influenced to use their land with due regard for erosion control and water conservation. The work of the agricultural extension service in many states has been effective in establishing practices of real value on a large number of farming areas.

Comprehensive control of erosion in the United States, however, is still a long way from realization. The demonstration operations of the U. S. Soil Conservation Service are intended not as a complete solution to the erosion problem in this country, but merely as guideposts helping to point the way toward solution. In point of fact, they cover something less than three per cent of our total agricultural area. Yet it is estimated that 75 per cent of this area is either actually or potentially subject to some form of erosion damage. There is real need of a mechanism whereby erosion control measures which have proved effective can be applied over considerable of our erodible land.

During the first six months of 1937 a significant step was taken in this direction. At this year's sessions the legislatures of twenty-two states passed enabling laws setting up state soil conservation committees and permitting the formation of local districts for the purpose of controlling erosion. It is somewhat difficult to generalize about these statutes since they differ somewhat in their detailed provisions. Certain common principles and methods of procedure, however, are distinguishable in all the laws which have been enacted.

If one feature of these statutes stands out, perhaps above all others, it is their completely democratic character. Under most of the laws ultimate authority resides in the local land occupier, who is defined as "a person or corporation who holds title to or is in possession of lands, whether

as owner, lessee, renter, tenant, or otherwise." In some states the authority is lodged in the landowner. In either case, however, there is no compulsion upon these individuals to take any action whatsoever. Before the formation of a district can even be considered, twenty-five land occupiers themselves must take the initiative by petitioning the state committee. Actual organization of a district can come only after public hearings have been held in the area and at least a majority of land occupiers voting in a referendum have signified their approval. Once created, the district is governed by a board of five supervisors, three of whom are elected by local balloting, and two appointed by the state committee. But no important step in procedure can be taken without consulting the will of the majority of land occupiers themselves, and numerous safeguards are provided to protect the individual against any possible injustice. Although the state committee has power to bring about an exchange of information and experience among districts and to coordinate the several district programs, it is only "so far as this may be done by advice and consultation." In the last analysis, each district is independent and not subject to control of the state committee.

Another highly significant feature of the soil conservation district is its provision for joint activity in the fight against erosion. Experience under the Soil Conservation Service demonstration program has clearly shown that erosion control is a job calling for collective action. This is true for a number of reasons. In the first place, erosion is no respector of artificial boundary lines separating one farm from another. It attacks whole watersheds or farming regions. It can be most effectively checked only when the work on each man's farm contributes to the protection of his neighbor's property.

Furthermore, a really thorough job of soil and water conservation often requires heavy equipment and more labor than the average farmer has available. It means getting the help of technical men and erecting structures, such as reservoirs or stock watering places, to benefit several adjoining farms. However, by sharing expenses, enlisting government aid, and pooling labor or other resources, a group of farmers, working through a district, can make real progress in bringing erosion under control. It is this cooperative character which makes the district so important both to the individual farmer and to society.

Once organized, the district functions as a governmental subdivision of the state, with all the privileges ordinarily pertaining to such units. In addition, it may exercise certain specialized powers necessary for the execution of an effective and well-rounded program of soil conservation. The district may conduct erosion control projects. It may enter into contracts with individual farmers and assist them in the formulation of soil conservation programs and the adoption of erosion control practices. If it seems desirable in the community interest, the district supervisors may formulate land-use regulations for submission to a referendum vote. In furtherance of its efforts, the district may call upon state, federal, or other agencies for assistance.

I think it is almost inevitable that, in the near future, a large number of districts will turn to the Soil Conservation Service for aid and advice. By its very nature, the Service is equipped to render assistance. The experience gained from operation of the demonstration program over a four-year period, combined with the knowledge obtained by other agencies, has crystallized into a comprehensive fund of practical information on soil and water conservation. The Service is conducting a research program in cooperation with the state agricultural experiment stations which involves scientific exploration of almost every conceivable phase of the erosion problem. Through these two programs the Service can provide a body of basic information which should be of considerable value to soil conservation districts, in the conduct of their operations.

Local districts offer the most effective medium for achieving, on a nationwide scale, the soil stability which is undoubtedly necessary for a permanently productive agriculture in the United States. Consequently, the Service stands fully prepared to cooperate with those districts which approach the problem of erosion control in an effective manner. The precise form of this cooperation cannot be established until an adequate background of experience has been acquired. It is impossible at this point to foresee all the eventualities which may arise.

A few principles of cooperation, however, can be rather definitely stated at the present time. The amount of the Service's aid to a particular district will probably be determined to some extent by the programs and work plans which are adopted. But, in general, the Service is prepared to provide districts with a certain amount of technical assistance, similar to that now being furnished to farmers under the demonstration program. As farmers in the demonstration areas have become familiar with erosion control principles and practices, they have been able to carry forward the program with a minimum of technical aid. Already about 100 demonstration areas have been placed on a maintenance basis with a skeleton technical staff, and during the coming year the number of projects on maintenance will be increased. As rapidly as technicians are released from project duty, they may be made available to districts where they are needed.

Such personnel can assist the districts in making conservation surveys, in formulating programs, in farm planning, and in supervising the adoption of erosion control practices on individual farms. They can also help in making necessary revisions and performance checks on the plans after they have been adopted.

In certain areas, where other types of assistance may be necessary, the Service is prepared to make available a limited amount of additional aid. This may be in the form of monetary grants or other services. It may include construction supplies, or planting stock of new or uncommon varieties of erosion-resistant vegetation. In all cases the total amount of such contributions should be matched by state or district funds made available for erosion control purposes. The policy relating to this type of supplemental service has not been fully worked out.

Under the district set up the line of authority and responsibility is clearly defined. The district supervisors are responsible for the adoption and effectuation of programs and work plans within the area. The state committee, under most of the laws, is responsible for the organization of districts, for assisting districts in securing aid from state and federal agencies, and for coordinating the several district programs. The Soil Conservation Service becomes a contributing agency rendering such assistance as may be mutually agreed upon.

The main job lies ahead. The responsibility is really three-fold, resting jointly on the federal government, the states, and the farmers. It rests on the federal government because the soil is a *national* resource, a concern of the whole people. It rests on the states because of their interest in national welfare, and because of their responsibility for dealing with matters within their own borders. And it rests on the individual farmers because they till the land and live by its products.

The federal government is already discharging a large share of its responsibility through the Soil Conservation

Service, the Civilian Conservation Corps, the Forest Service, the Agricultural Adjustment Administration, and other agencies. The states are doing their part through the extension services, the experiment stations, and other state agencies, and through the passage and administration of soil conservation laws. The next step is up to the individual farmer operating through the local district.

Today about three million rural landholders are in a position to organize themselves for land defense. According to census figures, there are that many farmers and ranchers in the 22 states which now have soil conservation districts laws. It is probable that about 50 districts will be organized during the present fiscal year. By the end of the fiscal year 1939 there may be as many as 150 in existence. At the next legislative sessions it is likely that other states will pass laws permitting the formation of districts. Eventually these local bodies should cover a significant portion of the country's erodible land.

The passage of soil conservation district laws by nearly half the states is an important milestone in our national progress toward better use of land and its resources. During the past several months Congress established two other milestones along this same highway. The Flood Control Act of June 1936 is significant in relating the problem of flood control with that of land use. The Water Facilities Act, passed at the last session of Congress, links up the problem of land use with that of water conservation.

In the so-called Omnibus Flood Control Act, Congress for the first time officially recognized the dual nature of the flood problem. It assigned responsibility for surveys and engineering work along waterways to the War Department. It invested the Department of Agriculture with authority to conduct surveys and provide measures for the retardation of runoff in watershed areas. Thus the flood problem will be attacked both in downstream danger zones and in upstream source areas. This is of interest to agricultural engineers because it means that more attention must be given to studies in hydraulics and other engineering problems involved in watershed work.

At the present time the Department of Agriculture is discharging a part of its responsibility through preliminary examinations of a large number of watersheds, conducted by the Soil Conservation Service, the Forest Service, and the Bureau of Agricultural Economics. The results of these examinations will be used as a basis for further recommendations. Eventually water-retardation work will probably be initiated in a large number of watershed areas.

Generally speaking, the type of work necessary for the retardation of runoff is identical with that necessary for the control of erosion. The specific measures and practices used may vary with the immediate objectives. Flood control may require certain supplementary measures not absolutely essential for soil conservation, but the two problems are closely related. Efforts to solve the one almost necessarily involve efforts to solve the other.

Under the Water Facilities Act, the Department of Agriculture is authorized to develop and carry forward a program for the conservation and utilization of water in arid and semi-arid states. This act states that any work carried out under its provisions must be such as to encourage good land use. To carry out the mandate of Congress under this Act, the Department of Agriculture does not propose to set up a new and independent program, but rather to expand and broaden some of the action programs already in existence. The Soil Conservation Service is one of the agencies being called upon to share in this work and help in making it effective.

It is worthy of notice that both the Flood Control Act and the Water Facilities Act contain provisions similar to Section 3 of the law which established the Soil Conservation Service. Section 3 of the Soil Conservation Act of 1935 is highly significant and worth quoting in full. It reads as follows:

> As a condition to the extending of any benefits under this Act to any lands not owned or controlled by the United States or any of its agencies, the Secretary of Agriculture may in so far as he may deem necessary for the purposes of this Act, require—
>
> (1) The enactment and reasonable safeguards for the enforcement of state and local laws imposing suitable permanent restrictions on the use of such lands and otherwise providing for the prevention of soil erosion;
>
> (2) Agreements or covenants as to the permanent use of such lands; and
>
> (3) Contributions in money, services, materials, or otherwise, to any operations conferring such benefits.

In the two recent statutes the wording is slightly different, but the principle is identical. Congress has clearly recognized this as an essential provision for safeguarding the expenditure of federal funds on programs involving conservation and land use. For the present at least, it is anticipated that states can satisfy this particular provision of all three federal statutes by the passage of adequate soil conservation district laws.

I commend these state laws to your attention. They will justify careful reading and study. I would also suggest that you look over both the Omnibus Flood Control Act of 1936 and the Water Facilities Act of 1937. All of this legislation charts the course which is being followed as we move toward an era of better land use.

The success of this movement, I feel sure, depends very largely on the wholehearted cooperation of all interested national, state, and local agencies, both governmental and private. In the past, members of the agricultural engineering profession have contributed much in the field of soil and water conservation. A great deal of additional study and research is now needed. I am confident we can depend on agricultural engineers for contributions of increasing importance in the future.

Engineering in a Changing Agriculture

By W. C. Krueger

AGRICULTURE has existed for thousands of years, the center of human activity. A great majority of the world's population was at one time directly engaged in the production and distribution of agricultural products. Muscle, land, or the size of the family was practically the only advantage one man had over another. Machines have changed all that. Man power has been released for added agricultural production, for the construction of more machines or the bringing into existence of luxuries and conveniences. Agricultural competition now includes the elements of machine power; it has become increasingly keen, with narrowing profit margins. The farmer's present targets are increased net profits through increasing his unit production, stepping up quality, and reducing labor and production costs. Agriculture has been beset by all manner of changing influences, but has made more or less effective adjustments, and in that measure has emerged an industry.

Without engineering this development would have been impossible. Agricultural engineering deals with the physical equipment and the mechanical means used in agricultural production and the farm activities incident thereto. It involves directly the farm engineering problems in soil conservation and development, farm structures, power and machinery, rural electrification, sanitation and water supply.

In a sense we are all extension engineers. Our objective is effecting agricultural adjustments through the application of machinery and equipment, the construction of suitable buildings for storage or processing, or the physical development of the land. We are engaged in applying our ideas and information to this purpose. We are changing agriculture to the end that it may keep in line with general social, economic, and industrial developments. We can ask, What has been accomplished, what have we to offer now, what are our plans or objectives for tomorrow?

Until recently, contributions in agricultural engineering were sponsored by individuals working through the equipment companies they founded or represented. The reaper, cotton gin, and tractor are examples. Progress still is dependent on individual ingenuity, but is now often speeded by organized groups. For thirty years the American Society of Agricultural Engineers has increasingly served as a coordinator of individual forces. Since 1923 the Committee on the Relation of Electricity to Agriculture has been a central and guiding spirit in a nation-wide movement for applying electric energy to jobs on a million farms. Agricultural engineering, as such, has had a place in college curricula for about thirty-five years, and extension agricultural engineers have traveled the highways and by-ways preaching the gospel of better methods and equipment for all of two decades.

Just as an index of what has been accomplished, an average 150-acre grain or potato farm today is using some twenty tons of steel. A few years ago it used little or none. In state after state the total acreage of cultivated farm land has steadily decreased during the past decade, yet the total investment in operating equipment has been increasing.

Today we must take the entire farm unit operations into consideration in planning or advising on a specific problem. The more the need and trend for specialization, the more necessity there is for the entire mechanism of production to be articulated. No longer can we extend our engineering program by the old divisions of farm power and machinery, farm structures, soil conservation, rural electrification, water supply, and sanitation. Rather must we apply agricultural engineering in terms of agricultural adjustments in dairy, poultry, fruit, vegetable, and grain farming. There will be duplication and overlapping of the program among these farm classes, but this approach offers a better way to tie our work in with that of the other specialists in the agricultural fields.

What is there ahead of us? Some think the job is pretty well finished, others consider it just started. Chemistry, physics, and engineering constitute a triumvirate on whose foundations no one can prophesy an agricultural load limit. If the national program of curtailment and control continues, we will have enforced intensification so long as limitations are on an acre or animal unit basis. The burden of keeping pace with farm equipment, machines, and methods is upon agricultural engineers.

So much of our so-called progress has been due to a series of substitutions. We concentrate on improving what is, rather than considering the job to be done and focusing on that problem all of the forces of modern knowledge—mechanical, physical, electrical, and chemical—which might contribute to its solution. Precedent too often serves as a brake on initiative. I think, too, we might save considerable time and speed progress by avoiding the repetition so common to workers in research, experimental, extension, and sales fields. A wealth of information in unrelated fields is available. It is our job to correlate and concentrate this material in the solution of our particular problems, if possible without repeating tedious fact-finding work already done. Conservatism is a virtue when dealing with unknowns, but when information is available, when all we need to do is *transplant* it to new applications, then conservatism stands in the way of progress. Many years ago Williams, when president of Sigma Xi, made a statement which holds true today, "He who only imitates the past forgets the demands of the present."

The consumer public is directly responsible for a large share of the farmers' problems, and indirectly for the demand for more and more engineering on the farm. Instead of selling bulk farm produce, the farmer is more and more required to process his products, grade, standardize, and clean them, package them in attractive containers, provide storage for off-seasonal demands, furnish transportation facilities, and even institute distribution and sales systems. All this calls for more machinery, higher investments, and increased production at the same price or higher quality so that better prices may be realized.

But is this the ultimate objective, to assist agriculture in the production of greater wealth and reduction of work, or should we also give consideration to such ideals as recreation, comforts, conveniences—a fuller life? After all, all human effort is reflected in terms of mankind,—improvements in machinery, crops, buildings, processes, gains in material goods, all are of no value without human interpretation.

Address of the chairman of the North Atlantic Section of the American Society of Agricultural Engineers before a meeting of the Section at Toronto, Canada, October 12, 1937.

Author: Extension agricultural engineer, New Jersey State Agricultural College. Assoc. Mem. ASAE. (Chairman, North Atlantic Section, ASAE, 1936-37).

Cribs and Granaries of Clay Tile

By C. T. Bridgman

THE STORY of the development of reinforced clay tile masonry is one that protrays the vision, imagination, and perseverance of the men who successfully carried the development work through the early stages down to the present time.

About the time Dr. J. B. Davidson was making some progress in developing an agricultural engineering department at Iowa State College in 1907, he and M. L. King started to work on the construction of silos, utilizing clay products. The solution seemed to require a curved silo block which manufacturers claimed could not be made. However, it was made and the manufacturing process developed to the extent that quite uniform blocks were obtained. After this difficulty had been overcome it was necessary to (1) develop a method of erection that would eliminate the expense encountered when silos were constructed by building scaffolding around the outside, and (2) get the silo into use.

In 1908 and 1909, Dr. Davidson and Mr. King supervised the erection of thirteen silos, many of which are still in use today. In the meantime clay tile manufacturers were improving the blocks, and shortly produced the double-wall silo block, greatly improving the completed wall. Before the silos were completed, a simplified scaffold was developed that greatly reduced the cost. It consisted of four uprights within the silo and wired to the wall. These supported a working platform that could be hoisted with ease. After a silo was completed the platform was lowered and the uprights removed and used for the next job.

During the time the silos were being erected, Mr. King applied the principal of the round reinforced construction to the design of a corn crib. He used standard two-cell tile in half lengths with the cells running through the wall. Wire reinforcement was placed in the horizontal mortar joints. This crib was the start of an extensive study that lasted from 1908 to 1919, and resulted in the development of the crib tile. During this time the agricultural engineering staff at Iowa State College worked closely with the clay products manufacturers, each making valuable contributions to the study.

There was considerable opposition to the round crib, so when W. G. Kaiser joined the staff in 1919, one of his first assignments was to design a rectangular crib. This was accomplished by using vertical members of reinforced concrete in the wall. In this same interval of time (1919 to 1926) many cribs of various shapes and sizes were built. These included round, oval, square, and rectangular shapes, with and without driveways and grain storage bins.

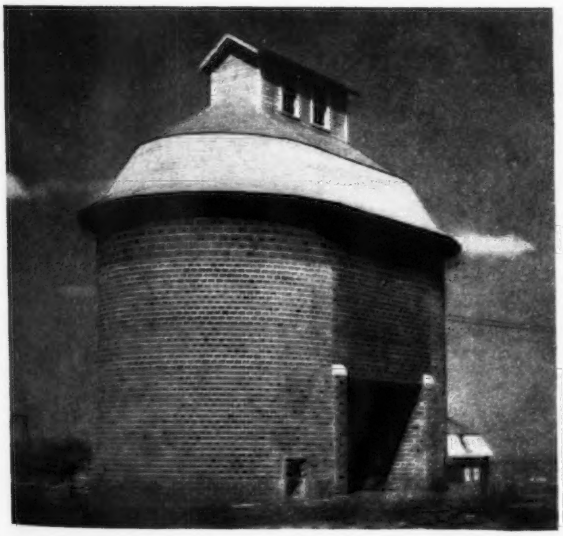
On-the-farm storage of farm commodities has taken on a new emphasis since the government has advanced its "ever-normal granary" plan. There is a general feeling that the present federal corn loan program has been set up as the basis for a permanent farm storage program. In effect, most leaders agree it is the beginning of the ever-normal granary in the corn belt.

The federal government isn't interested in buying or taking delivery on any corn. It is interested, leaders say, in providing the means to enable the individual farmer to store his grain on the farm, and by so doing to establish orderly marketing to support the price and carry over a reserve from years of good crop production to years of less favorable yields. In the past, the federal department of agriculture points out, only about seven per cent of the corn crop has been carried over from one year to the next. The carry-over of corn on the farms in the United States from one year to another ordinarily amounts to only about 170,000,000 bushels.

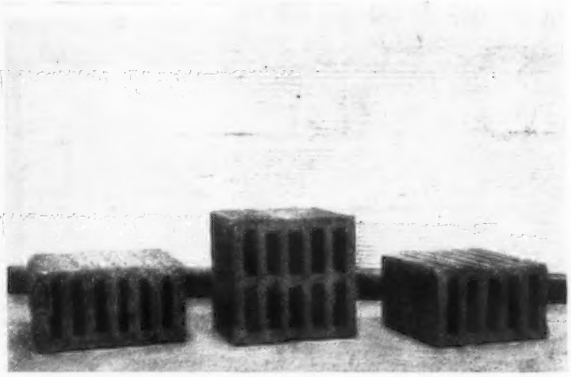
The 1937 corn crop is estimated at a little more than 2½ billion bushels larger than the small crop of 1936 and a little above the five-year (1928-32) average. Nebraska and Kansas are the only two corn belt states where the supply of feed grains per animal is below average. The supply of feed grains in proportion to animals is much above average in the portion of the corn belt east of the Missouri River.

Presented before the Farm Structures Division at the fall meeting of the American Society of Agricultural Engineers at Chicago, December 1, 1937.

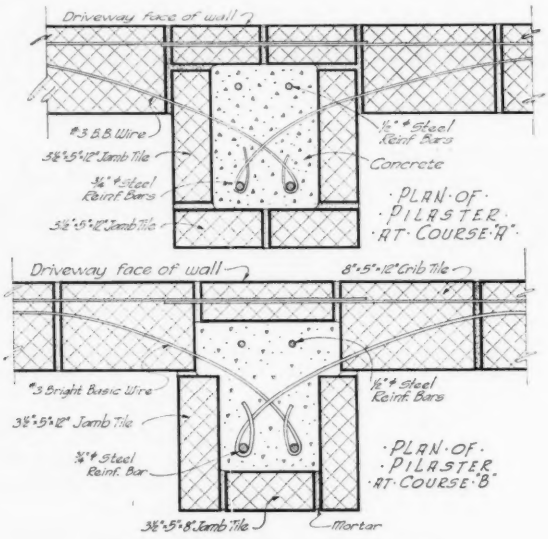
Author: Regional director, Structural Clay Products Institute. Mem. ASAE.



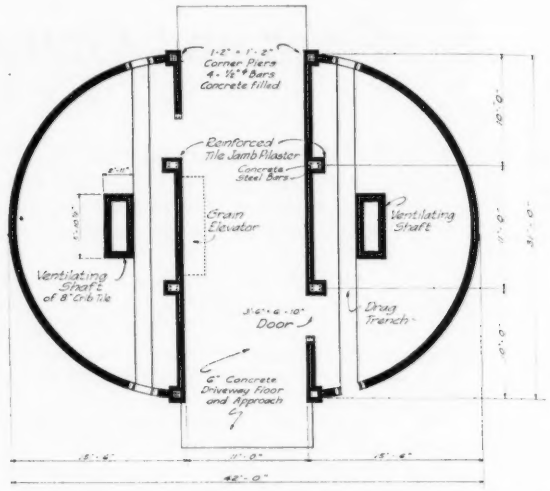
OVAL CRIB WITH GRAIN STORAGE ABOVE DRIVEWAY



TYPICAL STRUCTURAL CLAY TILE CRIB BLOCKS



DETAIL OF REINFORCED "C J" PILASTER


1'-2" x 1'-2" Corner Piers 4 - ½" ϕ Bars Concrete filled
Reinforced Tile Jamb Pilaster
Concrete Steel Bars
Grain Elevator
Ventilating Shaft
Ventilating Shaft of 8" Crib Tile
3'-6" x 6'-10" Door
Drag Trench
6" Concrete Driveway Floor and Approach
42'-0"

PLAN OF OVAL CRIB OF STRUCTURAL CLAY TILE, AT DRIVEWAY LEVEL. EXTERIOR WALLS ARE OF 8x5x12 IN BURNED CLAY UNITS

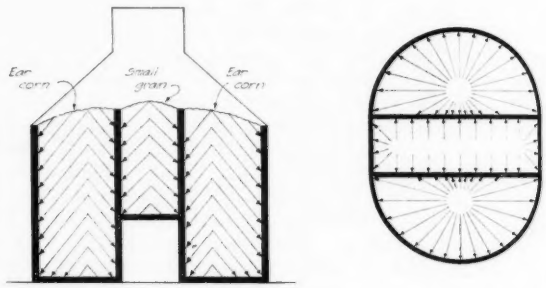


DIAGRAM OF FORCES ACTING ON WALLS OF OVAL CORN CRIB. FLUIDITY OF EAR CORN IS ASSUMED TO BE 0.4 AND OF SMALL GRAIN 0.5. (BELOW) HALF-SECTION AND HALF-ELEVATION OF OVAL CRIB OF STRUCTURAL CLAY TILE

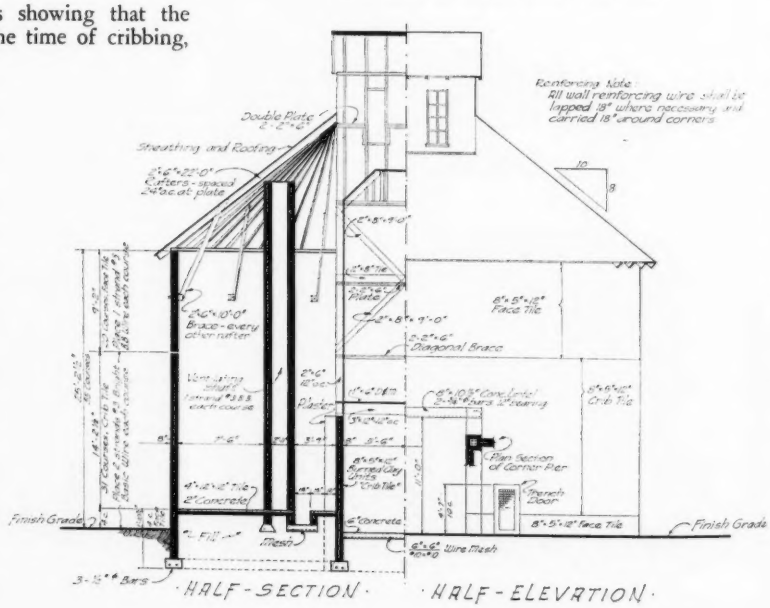
And here's what the department of agriculture, in its outlook for 1938, has to say about this condition. "Despite the prospective increased feeding of hogs and other kinds of livestock, the corn supply is such that there probably will be a larger than average carry-over of corn at the end of the 1937-38 marketing season. The carry-over may be unusually large in some of the corn belt states where production is above average and the number of hogs unusually small." I cite these facts to emphasize the growing need for adequate on-the-farm storage facilities.

Of major importance in the 1937 corn loan program, and obviously under the ever-normal granary plan, is the moisture content of the corn. This is especially important in years in which the season is unfavorable for the conditioning of corn. Corn eligible for a loan must have a moisture content of not more than 20.5 per cent, and must be stored in cribs which will dry out the corn and protect it from damage.

Undoubtedly you have seen tests showing that the moisture content of corn is high at the time of cribbing, and remains fairly high until April or May. During the summer months corn dries out rapidly, if properly cribbed, until it reaches a minimum moisture content. Poorly cribbed corn with a high moisture content at the time of cribbing has little chance to dry out, and may become unfit for feed or sale. It is important to the borrower, whether he obtains a loan from the government or from a private source, that his crib provide plenty of ventilation so the corn will dry out, and also furnish protection against weather and rodents. The borrower is responsible for loss due to poor storage, and it is in his interest that proper storage is provided.

We have found that the oval crib with a driveway and inside elevator with overhead bins is the most popular in Iowa. This type is also

(Continued on page 119)



New Barns for New Conditions

By Earl D. Anderson

DEFINITE improvement in farm buildings may be observed in the new program of repairs, alterations, and construction of new buildings. The barn, the key building in the production program on the farm, with its function somewhat changed by changes in farming and by increased knowledge of housing requirements, is being adapted to meet new conditions. Steel is playing an important part in this new architectural treatment of the barn.

In order to obtain a premium price for milk, the farmer may be forced to change his barn design to meet rigid city milk codes. Under the stress for higher production, changes may be necessary to protect the animals from disease and to prolong their lives.

The farmer may wish to effect more pleasant working conditions and to reduce his labor costs in caring for stock. Change of ownership and change in farming enterprises may make the present barn unsuitable. The farmer is looking for buildings which will give more service and require less maintenance.

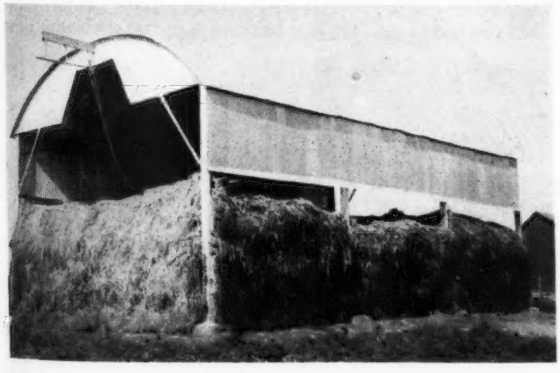
Windstorms and fires each year exact a tremendous toll of farm barns, and the farmer who has suffered a loss from either cause looks for a type of construction which will minimize these hazards.

The development of new machinery and methods for processing and storing hay has been an extremely important factor in influencing a new style of architectural treatment of the barn.

Depreciation, ever active, has proceeded at an accelerated rate during the recent period of depressed prices for agricultural products, since many building repairs were necessarily postponed. However, with recent increases in purchasing power on the part of the farmer, many of these repairs and alterations long delayed are now being made. Some buildings, for lack of repair at a critical time, have deteriorated beyond the point where they can be repaired economically and replacement of the entire structure becomes necessary.

Presented before the Farm Structures Division at the fall meeting of the American Society of Agricultural Engineers, at Chicago, Illinois, November 30, 1937.

Author: Agricultural engineer, Republic Steel Corporation. Mem. ASAE.



AN ALL STEEL HAY SHED

The foregoing factors are turning the spotlight of attention on the barn and challenging the best efforts of those to whom the farmer turns for assistance in his building problems.

Galvanized metal sheets are finding new applications in making barn repairs. They have gained a recognized place as a fire-resistant roofing material, because of the protection they offer against sparks on roofs and the transmission of fire from one building to another. Siding boards, which may not in their present condition be satisfactory for that purpose, may serve as a base for the speedy application of metal sheets, to provide a weather-tight wall. Greater warmth may be obtained by replacing badly weathered siding boards with rigid insulation boards, over which metal sheets are applied, or by using a loose fill insulating material in the wall. Inside the stable a clean bright surface, requiring little maintenance, and greater fire resistance, may be obtained by using metal sheets. Their ready application to ceilings, made possible by the development of satisfactory formed flashing and trim, is a great advantage from the standpoint of cleanliness. Tight-fitting metal window sash admit a maximum of sunlight, reduce air leakage and assist in providing adequate ventilation without draft. Insulated, metal-clad doors complete the fire-resistant enclosure. Grain loss from rodents is reduced by the use of perforated galvanized sheets in the construction and reconditioning of grain bins in barns.

The common two-story barn with hay storage above the stable was an achievement in design and ideally fitted to our early agriculture. At first constructed as a bank barn, a comparatively warm stable was provided for the livestock. Hay was more conveniently stored above from a central driveway by hand than in a stack outside, and more conveniently fed to the livestock below. With the advent of hay unloading equipment for barns, this type of structure was adapted to the prairie states without building a ramp to the mow floor for unloading hay.

The primary purpose of the livestock barn, however, is to provide shelter for the livestock. Yet by custom we have provided a tremendous space above the stable for the great bulk of loose hay and bedding. True, the same roof covers both the stable and the storage space, but to support this great weight high above the ground with a minimum of internal supports, and to give the structure sufficient wind resistance, the cost of the structure is higher than need be.

Perhaps the greatest limiting factor in new architectural treatment of the barn has been this supposed necessity of providing a convenient storage space for feed, directly above the stable. Heavy timbers required for framing to support the heavy load were easily obtained from native woods, and community barn raisings were common. Carefulness in curing hay was handed down from father to son, and the native grasses put up for hay were not as susceptible to spontaneous ignition as our present-day legumes.

The increased use of legumes in the livestock program has been an important factor in reducing feed costs and in restoring and maintaining the fertility of the soil. However, in an effort to conserve the feeding value of hay, a large part of which is concentrated in the leaves, the hay

too often is stored with a high moisture content, and, being strangely susceptible to self-heating, tremendous losses have resulted. In the common type of barn, spontaneous ignition of the hay usually results in a total loss of the hay itself, the barn, and often the livestock, as well as adjoining buildings, due to the limited fire-fighting facilities available to the average farm.

Analysis of rural fire losses in Iowa[1] shows spontaneous ignition as the principal cause of barn fires, being responsible for approximately 37 per cent of the total fire loss to barns, where the cause was known.

Recent research has proved that common methods of harvesting and storing hay not only present a fire hazard, but are inefficient from the standpoint of food nutrients lost. Through the development of new machinery and methods of harvesting and storing hay, these difficulties may be overcome to a large extent.

Artificial dehydration of hay reduces the moisture content to a point safe for storage and the resulting feed may be stored in bag or in bulk, in an inexpensive structure, for convenient feeding.

The new pick-up hay baler is becoming increasingly more popular as an efficient means of preparing the hay for storage. In the baled form, the hay requires only one-third the storage space necessary for loose hay, and is more conveniently handled in storing and feeding.

Two methods of making hay silage, the AIV and the molasses method, are finding increased use. The hay is chopped either at the storage site or in the field, and the acid or molasses is added as the hay is blown into the silo. The hay silage is free from self-heating and retains its food nutrients with a minimum of loss.

The first use of the hay chopper in many cases presented several unforeseen problems. As first practiced, the hay was chopped in too short lengths, and frequently self-heating was increased, due to the greater density of the mass. Also, some farmers attempted to store an increased weight of hay in the mow, since less space was required for their crop, resulting in failure of mow floors unless reinforcing were added. Further experimentation, however, has shown that by increasing the length of cut, the self-heating hazard may be reduced considerably. Separate structures specially designed for storage of dry, chopped hay have further reduced the danger from spontaneous ignition.

Since the ventilated metal hay container has been developed primarily to provide a storage space for dry chopped hay, isolated from the livestock stable, a brief description of its design will be of interest. The structure, resembling a silo in shape, has an outside diameter of about 25 ft and is 40 ft high. It has a capacity of approximately 100 tons of chopped hay in the circular bin provided. The outer wall is tightly covered with galvanized metal sheets on the outside of the studdings and on the inside with louvred sheets. Continuous air intake to the flue thus constructed is provided by leaving an opening between the studdings at the base of the wall. The width of the bin is limited to 9 ft 10 in by the construction of a central hay chute, also covered with louvred sheets. Dormers are provided on the roof for convenient filling and the central hay chute contains large doors on two sides at alternate levels for convenience in removing the hay. The walls and roof are tightly anchored. This structure is usually located adjacent to the barn and connected by a metal-clad passageway to the barn proper.

[1]Rural Fire Waste in Iowa. Iowa Agr. Exp. Sta. Bul. No. 296.

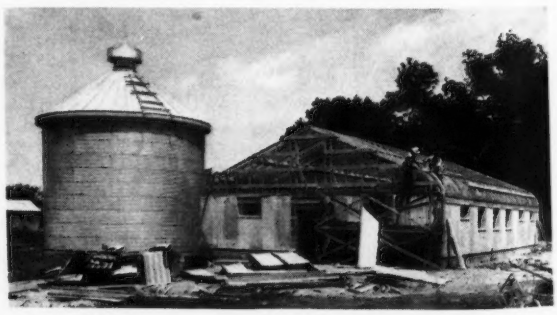
Recently the design has been changed slightly to provide storage for three different crops. In the new design the height of the 100-ton container is reduced to 24 ft and the outside diameter increased to 35 ft. The width of the circular bin has been reduced to 7 ft 3 in and may be used to store a total of 72 tons of two different crops by inserting a vertical, wire-mesh partition. Approximately 28 tons of a third crop may be stored in an inner ventilated bin. Larger wall flues also have been provided by using 2x6-in instead of 2x4-in studding.

The new style of container offers several advantages over the previous design. It is more easily constructed because of its lower height, and less power is required for filling. The narrower width of bins, in which the maximum distance to a ventilated wall surface is only 3 ft 7½ in, and the larger wall flues give the hay better ventilation, thus improving the keeping quality. The additional width of the structure overall provides additional space for storage of feed concentrates at the ground level under the center bin. A new 45-ton container is also being planned by the manufacturer of this type of hay-storage unit.

Segregation of the hay in a separate, fire-resistant storage building, away from the barn, probably is the best means of reducing the fire loss from spontaneous ignition of hay. With this arrangement, if a fire should start in the hay, it would tend to be confined to that structure with a resulting minimum of loss. Dust from feeding the hay is also reduced, producing a cleaner atmosphere in the stable.

Since it is no longer necessary to provide storage space in the barn for roughage, the stable may be reduced to a one-story structure, with resulting advantages. Using essentially the same floor plan as before, bracing becomes simplified. The immense overhead weight has been removed and the lower structure is a smaller target for wind storms. True, insulation must be added to the ceiling for equivalent warmth since the insulating value of the hay previously stored above may not be utilized, but with the many new insulating materials now available, this is accomplished easily.

A satisfactory and economical design for a composite one-story stable has been developed using galvanized sheets over conventional wood framing in the walls and roof. This type of structure gives many advantages of an all-steel structure, and utilizes materials with which the average country building contractor is familiar. The latest structure of this type is the so-called "streamline, metal-clad unit", recognized by its gable roof and curved eaves similar in shape to those used in the modern greenhouse. Elimination of the time-honored cornice represents a distinct change in architectural treatment, but at the same time



ONE-STORY, METAL-CLAD, WOOD-FRAME BARN UNDER CONSTRUCTION

results in a saving of materials and labor, and presents a pleasing appearance, harmonizing with the landscape. Curved end pieces sawed to the proper radius for framing the eaves are furnished by the manufacturer. This eliminates the necessity for having these sections cut by local carpenters, speeds the job of erection, and insures the proper fit of the formed sheets covering that portion of the roof. All other framing material may be obtained from a local source.

Roofing sheets are laid over an open slat deck and siding sheets both inside and out are attached to nailing girts. The sheets may be applied directly to the ceiling joists. Construction is facilitated on this type of structure since the builders do not have to work at great heights.

Planer shavings, in conjunction with building paper, are most commonly used for insulating walls and ceilings of these stables, because of their high insulating value. Tests for overall heat transmission conducted by the designer of these buildings showed walls of the construction described to have a heat resistance of 19.40—approximately three times the resistance of a wall made up of wood siding, paper, sheathing, ½-in insulation board and ceiling. Other types of loose fill insulation or rigid insulation boards may be used if preferred. The width of these buildings has been standardized at 36 ft.

Commercial production of steel-framing units for barns dates back at least to the year 1914. One of the first of these roof arches was designed similar to the common plank truss and used in the construction of two-story gambrel roof barns. In a later design a curved arch was developed to produce a gothic type roof. In each case the roof and walls were clad with galvanized sheets, producing a wind and fire-resistant structure. These early roof trusses, however, undoubtedly were much heavier than need be, with resulting relatively high cost, compared with other common building materials.

Steel framing members, however, find a more ready application to the one-story stable, where lighter sections have been used. In a comparatively recent design, both wall columns and roof members are of light, open-web sections fabricated at the factory and assembled in the field by bolting together. Wall columns are bolted to the masonry foundation, and longitudinal sections, to take care of end sway, are bolted to the roof members both at the peak and at the eaves.

The building is roofed and clad both inside and out with galvanized metal sheets. Either loose fill or rigid insulation may be used for insulating walls and ceilings. The roof is arched and requires no internal supports. The standard width is 36 ft.

The potentialities for steel in barn construction have been far from fully exploited. Extensive research programs are in progress in the steel industry, aimed at a more extensive use of steel in residence construction. Many new light structural members of high strength, new methods of fabrication, and new combinations of steel with other building materials are being developed. As in the case of many new methods of construction which have first found acceptance in residence construction, these new developments in the use of steel may be expected to be adapted to the barn and other farm structures. Research programs in the farm structures field, recently initiated by some of the major organizations in the steel industry, both in their own laboratories and in cooperation with educational institutions, should hasten the development of a more extensive and more intelligent use of steel in the barn. Steel has many inherent qualities which make it desirable as a building material. Used judiciously in those parts of the structures where it serves the purpose best, and in combination with other materials where such use will be more satisfactory, steel offers great possibilities for further improvements in farm barns.

Cribs and Granaries of Clay Tile

(Continued from page 116)

the most economical to build when the driveway and overhead bins are a requirement.

The round crib with a center ventilating shaft, as a storage structure for ear corn, is surprisingly low in cost. This type should be increasingly popular under the ever-normal granary program; 3,000 to 10,000 bu can be housed in units of this design.

To give an accurate picture of the cost and design of the structural clay tile crib, as now constructed, I will describe one recently completed near Nevada, Iowa.

This oval crib has a driveway, inside elevator, and overhead bins, with a capacity of 8000 bu of ear corn and 5,000 bu of small grain. In the center of each crib section is a tile ventilating shaft. Structural features include a reinforced concrete footing, tile foundation walls, and load-bearing crib tile walls, reinforced with No. 3 bright basic steel wire in each horizontal mortar joint. The straight walls through the driveway are supported by pilasters reinforced vertically.

The floor over the driveway is of 3x12-in joists, spaced 12 in on centers, and two thicknesses of sheathing. Partition walls are wood, carefully tied and braced. The structural design has been carefully worked out so that the walls are reinforced to carry the loads placed on them.

Properties of the tile used include a compressive strength of 2000 to 3000 lb per sq in over the gross area of the block, and absorption below five per cent.

Mortar used was mixed to the proportion of 1 part portland cement, 3 parts sand, and ⅓ part mortar mix.

The crib is so constructed that the cost of upkeep will be small and the service life long. How long we do not know, but we believe it should give at least 100 years of service.

This crib cost, for materials, $2,660.70, and for labor, $1,134.74—a total of $3,795.44.

Erection was all done by local builders. The crib was sold and the construction supervised by the local building materials dealer. This crib is one of several on which observations are being taken on the effectiveness of different types of cribs in curing ear corn. This study is being conducted by the U. S. Bureau of Agricultural Engineering and the agricultural engineering section of the Iowa Agricultural Experiment Station.

Several cribs of this type have been built this past year using the tile joist floor construction over the driveway and reinforced tile partitions in the grain storage above. Cribs of this type have been costing very close to 30 cents per bushel of storage capacity. Circular cribs, without the driveway and grain bins, can be built for about half this cost.

Agricultural Engineer the Key to Better Values

By Elmer T. Wible

I SHALL endeavor to show how the agricultural engineer is the key to better values for the farmer.

Twenty-five or thirty years ago, when most manufactured products were priced at lower levels than today, because labor and materials costs in those days were only a fraction of what they are now, the popular weight of farm fence was No. 9 gage. Many of the roofing sheets of that period were No. 26 gage. In the period since that time, during which manufacturing costs have crept upward, there have always been certain sellers who have based their selling appeals on low prices.

Fences were offered popularly in No. 11 gage, then in No. 12½ gage, No. 13 gage, and even No. 14½ gage. No. 9 gage wire weighs 310 lb per mi; No. 11 gage, 204 lb; and 12½ gage, 136 lb. There is only about one-third as much steel in No. 12½ gage wire as in No. 9 gage wire. Of course it can be sold at a lower price, but it cannot be expected to serve the purpose so well nor so long as the heavier gages. Roofing sheets were popularly offered by those selling on the price appeal in No. 28 gage, and even No. 29 gage is entirely too popular in today's market. The thickness of a No. 26 gage sheet is 0.019 in, No. 28 gage 0.0155 in, and 29 gage, 0.014 in.

Consider how helpless the conscientious manufacturer has been to stop this competitive trend toward lighter weight and poorer value steel materials. He has known that the heavier materials meant better value for the farmer, has so stated in his advertising, and has talked it through his dealer contacts. But his statements were discounted. He was considered biased—as wanting to sell the higher priced materials. The dealer, also, feels the pressure from the farmer for low cost roofing. Take the matter of Seal-of-Quality roofing sheets, for example. These quality sheets have been accepted by the trained industrial buyer, a man who is entirely conversant with the findings of such organizations as the American Society for Testing Materials, and perhaps he has his own research laboratory to demonstrate the value of the heavier zinc coating, so he willingly pays the added price premium, knowing that it is economy to do so. But what about the farmer? Seal-of-Quality sheets have been available from manufacturers for many years. These manufacturers would be glad to sell the better merchandise, yet I doubt if today you can find any stock of Seal-of-Quality roofing sheets in one out of fifty retail stores handling sheets.

For the first time in the history of fence manufacture, there are on the market today some brands of wire fences containing approximately one ounce of zinc per square foot of surface. (I would like to point out here that a 1.0-oz coating of zinc on wire is exactly equivalent to a 2.0-oz coating on sheets, 1.0 oz on each side of a sheet one foot square.) I think it is remarkable that fence of this quality is available at the present time, but I am frank in saying that I do not know whether it will continue to be available. Obviously it costs more to manufacture than some fence that is offered in competition with it with zinc coatings ranging downward from about 0.6 oz to as low as 0.2 oz. If the low-price, low-quality competition is so successful as to make it utterly impossible to manufacture this better grade product and sell it at a profit, farmers will lose the benefit of the superior values.

As an indication of the relative economy of these better quality products, the cost of the steel wire used in fence is a constant; the steel costs the same to produce whether subsequently 0.5 or 1.0 oz of zinc is applied. For a certain gage of wire, let us say, this steel cost is $60 per ton. In galvanizing this wire it is passed through an annealing furnace, pickling and cleaning tanks, and a galvanizing process. The labor cost of galvanizing also is practically a constant whether the 0.5-oz or 1.0-oz coating is applied. We can estimate that cost for 0.5-oz coating at $5 per ton, and at about $6.50 per ton for the heavier coatings. The only important variable, therefore, is the amount of zinc used, which in No. 11 gage wire will amount to about 125 lb of premium quality zinc for a 1.0 oz coating and 63 lb of prime western zinc for a 0.5-oz coating, representing a difference in cost of zinc amounting to about $4.75. The manufacturing cost therefore for 0.5-oz coated wire fence is approximately $68.50, and for 1.0-oz premium coated wire fence $74.75, an increase cost of about 10 per cent for fence which will, judging by the ASTM tests that have been conducted for zinc coatings on sheets, wear 100 per cent longer before showing rust. If that added 10 per cent cost isn't a good investment for 100 per cent increased freedom from corrosion, then I don't know buying economy.

The manufacturers alone cannot convince farmers of these better values. That is where we need the help of the agricultural engineers. Our advertising claims, quite naturally, are discounted. The same claims made to the trained industrial buyer are not discounted because he has his own unbiased authorities to verify them.

In the case of the farm market, what is vitally needed is for the agricultural engineer to function as the trained buyer or counsel, the source of unbiased information that will enable farmers competently to select these better values. Fortunately you have supporting you in this not only the industrial research organizations such as the ASTM, but also the facilities of many university laboratories. It is only through your efforts that the farmer is likely to become a trained buyer who buys on specifications in any way comparable to the trained industrial buyer.

When I refer to this sphere of influence for the agricultural engineer, I am really thinking of that entire group of agricultural educational influences that includes agricultural colleges, county agricultural agents, vocational agriculture instructors, and other groups represented here. Although not all of the persons in all of these groups are members of the ASAE, they all come under its influence.

Therefore, concerning not only the specific products to which I have referred, but probably many others purchased by farmers, the manufacturers who sincerely want to give farmers better values need your trained assistance, your salesmanship, as an essential factor in making available to farmers through the regular channels of trade, better values conforming to such specifications as you, through available research facilities, determine to be in their best interests.

Presented before the Farm Structures Division at the fall meeting of the American Society of Agricultural Engineers at Chicago, November 30, 1937.

Author: Advertising manager, Pittsburgh Steel Company. Assoc. ASAE.

A Demonstration of Better Fence Building

By Frank J. Reynolds

AFTER SOME investigation in the spring of 1937, we found that a great many of the multiple land owners, in particular land banks, insurance companies, and other mortgage companies, as well as landlords who own large groups of farms, were having trouble with their fence-building programs. It appeared that there were not many competent fence builders available, also that a great many farm leases require that the tenant furnish the labor for any new fence that is built or repair work that is done.

Because of the new group of purchasers in the fence market, we felt we had a larger obligation, and that our dealers had a larger obligation, to satisfactorily fulfill the needs of this new group of buyers. With the cooperation of five of the major insurance companies that are large land holders in Iowa and Missouri, we inaugurated a campaign to encourage better fence building. In this campaign there were three participants: the insurance companies our dealers, and ourselves.

The insurance companies brought together their field agents and fence builders at central points in the two states in which we worked. At five different places in Iowa and Missouri those companies assembled in the neighborhood of one hundred farm managers who control 10,000 farms. In cases where they maintained fence building crews, those crews were also brought to the demonstrations.

The fence dealers in whose localities the demonstrations were being held furnished men to help with the work. Those men received training under expert fence builders. The dealers who participated now have men whom they can send out on fence jobs, should the consumers wish such aid. In some cases, I believe we started men developing a trade of their own. By having our dealers and local men participate in the demonstrations, we feel that we put them in a better position to serve their customers.

At all of the demonstrations that we held in Iowa and Missouri, we used the 32-in fence with four strands of barbed wire above it. We constructed a 50-in fence on 6-ft steel line posts and steel dirt-set end and corner posts. At those demonstrations, we built from 80 to 160 rods of fence over any kind of ground that the owner wished to have fenced.

The first thing done at the demonstrations was to locate the ends of the fence line. Dirt-set end or corner posts, whichever were needed, were placed at those points. It took from 13 to 16 min to set an end or corner post. This, of course, caused some comment. Most of the spectators were accustomed to spending from three hours to a day making what they considered a good corner post set-up.

The barbed wire was stretched from one end post to the other to give a line for setting the intermediate posts. When going around a curve, of course, the barbed line wire had to be moved over to the desired line and attached to a post. The other intermediate posts were then placed in position.

The line posts were driven with an 18-lb sleve driver to within 2 or 3 in of the desired depth. After the line posts were set, the woven wire was unrolled, so that the inside of the roll would be laid against the face of the posts. Following this rule avoids baggy fence. The woven wire was fastened to the end posts by attaching the bottom wire first and then pushing it down the post, to avoid working in the dirt.

Our method of stretching lengths of fence over 20 rods was to attach a double stretcher at the roll ends near the center of the fence line. The fence was pulled to the proper tension, which in the summer time was approximately 1600 lb for No. 11, 32-in fence. Practically speaking the tension curve was pulled to one-half its tensionless size.

When working on fairly level land, the fence was pulled up to the proper tension and spliced. On land of very rough topography, it was necessary to first pull the fence to the proper tension. Over high places we hung it on a tripod of two steel posts to keep it from fouling in the brush. Across the low places, of course, the fence was lifted by the stretchers to a place about level with the higher points.

After the fence was up to the proper tension, workers started clipping from both ends of the fence line. When the clippers went down into ravines, one man worked two or three posts ahead of the clipper to get the fence down near the ground. The man at the stretchers watched the tension curves. As he saw them being overpulled, he released the stretcher so as to keep the fence at uniform tension. In these cases, the woven wire is clipped before the fence is spliced. If the fence is kept at the proper tension, a steel post driven deep in the ground at the bottom of the ravine will usually hold it until the wire has become set and the tension released. If the ups and downs on the fence line have not equalized themselves, it may be necessary to put additional crimps in some top or bottom wires to unify the tension on all of the line wires.

Most fence builders overpull the fence when building it across irregular topography. That is usually why the fence posts at the bottom of ravines are pulled out of the ground when cold weather causes the fence to contract. If the tension curves are not overpulled, they will take care of the expansion and contraction of the fence, without exerting such a strong lift on the posts.

The barbed wire was pulled to a proper tension, which was about 250 lb on 12½-gage barbed wire. Most people put too much tension on it. That is why barbed wire breaks in the winter. We spliced all of the strands of barbed wire at once so the clippers could attach them with one trip along the fence line. A wire spacer was used as a guide for locating the barbed wire and the upper line wire of the woven fence at the proper distances from the top of the posts. This method kept the top of the fence and posts a uniform distance from the ground line. The last job was to go along with a sledge and drive the posts the last 2 or 3 in to bring the bottom of the fence down to the ground.

Presented before the Farm Structures Division at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill., November 30, 1937.

Author: Manager, agricultural extension department, American Steel and Wire Company. Assoc. ASAE.

A Rural Electrification Extension Program

By R. R. Parks

EXTENSION work on rural electrification in Illinois has evolved into three general services (1) organization for securing electric service, (2) wiring and selection of equipment, and (3) utilization. Any well-founded extension program seeks to do the things that are most needed and popular in the field at the time. For the past two years, rural electrification in Illinois has been expanding at such a rapid rate that the only course to follow is to assist interested communities in organizing for electric service. This usually involves a number of organization meetings and county and local surveys, to test out the interest in the community for using electricity if the lines are built. We find that many communities are not ready for electricity due either to lack of income or general lack of education toward a better standard of living. These neighborhoods must be culled out, of course, and the remainder have a better opportunity to qualify for service, either from a private company or from their own cooperative venture. Frankly, the Illinois extension service has tried to stay clear of the actual negotiations for electric service, either from a private company or a cooperative organizing with REA funds. Whether or not this is the correct policy, time will tell. There is plenty of work to be done in organizing communities and training leaders.

Occasionally during the past few months, it has seemed that the need for organization work is quieting down. Too, the general procedure for organization work has been so publicized that there is not the call for specialist help now that there was originally. More time can now be given to wiring and selection of equipment, ultimately to work toward utilization programs.

Some of the most interesting and seemingly productive extension meetings in Illinois have been held on wiring solely. It is an excellent subject for educational work on the whole electrification program. There being no inspection code in Illinois for rural districts, educational meetings for farmers and wiremen are considered very valuable. The practice of installing 60-amp three-wire entrances is stressed, along with the importance of convenience outlets, greater numbers of circuits, convenient switches, and tamperproof fuses or breaker-type load centers. Another recommendation stressed in the wiring meetings is that of using completely nonmetallic wiring systems in barns and other outbuildings.

There has been quite a demand for meetings on the selection of electrical equipment. Most of these have come from home bureau units. Again there is an opportunity for an interesting meeting explaining good lighting, the reasons for certain lighting practices, and discussing the actual location and size of lights in a typical home. The points to be considered in the selection of ranges, refrigerators, washing machines, ironers, irons, water heaters, and the smaller pieces of equipment always make interesting discussion matter, although one must be careful not to play up too strongly patented features obtainable only on certain pieces of equipment.

The third classification of extension service on rural electrification is that of utilization, which is not divorced at all from the other two classifications of work, but it is a subject we will all be confronted with sooner or later, and our plans of work must be contemplating that need. It is well known that many lines are now being promoted on a below-cost proposition to farmers. The only way possible for those lines to prove to be self-supporting will be for someone to work especially hard on utilization. If the farmer finds more jobs for his utility motor, he will possibly buy another or two for semi-stationary jobs. If the housewife finds greater use for her electric refrigerator and especially enjoys its convenience, she will normally consider the addition of an electric range or an electric water heater. One satisfying electric appliance usually builds a sale for another.

To supplement meetings work, such activities as a training school for wiring inspectors, a rural electrification short course, and a string of demonstration farms over the state seem to fit very well into the Illinois program. The rural electrification school for rural service men is being combined with farm and home week sometime in January of each year. Demonstration farms are selected on the basis of their number of uses, their standing in the community as representative farms, and the willingness of the operators to furnish a small amount of additional information besides the meter readings which the power company takes each month. The meters are installed and read without cost to the extension service. We are collecting pictures from them and will eventually have a film strip of practical uses and their costs in Illinois.

Approximately 5,000 persons have attended 72 meetings, at which the specialist has been called into, this year. A number of these have been only committee meetings at which a half dozen or more farmers would get together to discuss their county program as a committee. Fully 85 per cent of the counties in Illinois are carrying rural electrification as a regular organized project. In the state as a whole, some 9,000 miles of line will have been built in the last two years to serve some 25,000 new customers. Approximately one-third of this building will have been done by electric cooperatives and two-thirds by private companies. This will mean an increase in the percentage electrification figure for Illinois from approximately 13, in the early part of 1935, to approximately 22 per cent with the completion of the present building program. Up to now the average current consumption in rural Illinois has been approximately 100 kwh per month, for which the customer pays approximately $5.00. No doubt this expansion program will lower this figure for a while, but on the whole, new users seem to turn out to be better than the old ones in a surprisingly short time.

Presented before the Rural Electric Division at the fall meeting of the American Society of Agricultural Engineers, at Chicago, Illinois, December 2, 1937.

Author: Extension agricultural engineer, University of Illinois. Mem. ASAE.

Watercycle Lysimeters for Watershed Studies

By Herbert S. Riesbol and George L. Sherman

LYSIMETERS adapted to the detailed analysis of the hydrologic cycle in its relation to watershed studies were designed and constructed on the North Appalachian experimental watershed by the U. S. Soil Conservation Service. The watersheds included in these studies range in size from one acre to 5,000 acres and were established to determine the effect of agricultural influences upon hydrologic events.

Quantitative measurements of precipitation and surface runoff from the watersheds and amount and rate of change in ground water levels represented measurements that could readily be made upon the larger areas, but did not trace other important factors of the hydrologic cycle, such as rate and amount of infiltration, deep percolation, evapotranspiration, and soil moisture. Since it was recognized that these hydrologic factors might be greatly influenced by land-use practices, it was decided that an attempt should be made to evaluate and correlate them in relation to watershed studies. To do this, lysimeters were constructed directly adjacent to typical small watersheds which represent the average conditions of soil, slope, and land use.

DESIGN

Type. Careful study of the literature and inspection trips to several of the best known lysimeter experiments revealed that lysimeters are of several basic types and that none of the installations inspected were sufficiently complete in their design for the purposes of the North Appalachian study.

There are three basic types of lysimeters that vary principally in the manner by which the block of earth used in the study is isolated. Thus, in the Ebermeyer and Joffe lysimeters, the block of earth is not isolated by sidewalls, there being no restriction to lateral movement, but is simply opened underneath by a tunnel and the percolating waters caught in a collecting funnel. In the replaced type a box is constructed in the final location of the installation, and the soil to fill this box is removed from a selected site and replaced in the lysimeter box in carefully graded and assorted layers. The *in situ* lysimeter isolates a block of soil both in lateral movement and in vertical movement without disturbing in any way the natural structure of the soil.

One method of building the *in situ* lysimeter consists of constructing a box in the final location, then filling it with soil brought in cubes from a selected field site to the lysimeter box, where they are placed in proper juxtaposition. Another *in situ* method studied consists of selection by field study of the proper site for the proposed lysimeter, and the isolation of the block by vertical walls and horizontal drainage collectors. The last method described was the one selected for use in the North Applachian studies, as it appeared to offer the greatest possibility of approaching natural hydrologic activity. Due to the highly stratified character of the rocks which form the parent material for many North Appalachian soils it appeared that lateral movement might be considerable and that the Ebermeyer type of lysimeter would be inaccurate. The replaced or refill method, on the other hand, would destroy the natural structure of the soil, thereby entirely changing the hydrologic behavior. The multiple-block method was abandoned because of the possibility of seepage planes forming between the adjacent sides of the cubes. It seemed that the *in situ* method would be most desirable for accurate

Presented before the Soil and Water Conservation Division at the fall meeting of American Society of Agricultural Engineers, at Chicago, Ill., December 2, 1937. Approved by the Soil Conservation Service, U. S. Department of Agriculture, and by the Ohio Agricultural Experiment Station, for first publication in AGRICULTURAL ENGINEERING.

Authors: Respectively, associate hydraulic engineer (Mem. ASAE) and junior hydraulic engineer, Soil Conservation Service, U. S. Department of Agriculture.

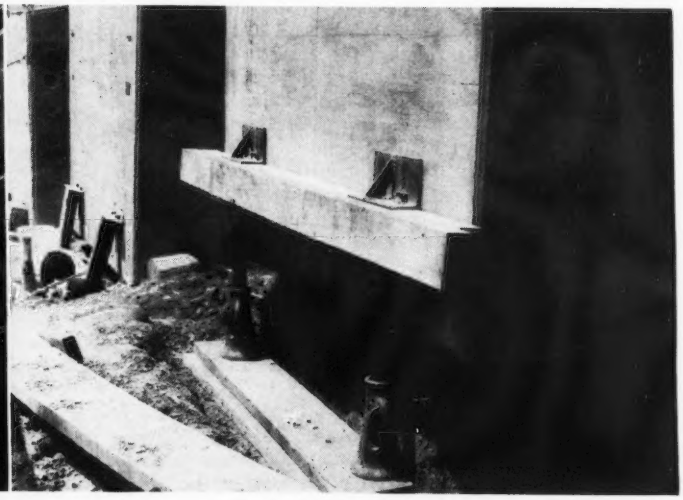


FIG. 1 (LEFT) GROOVES FOR PLACEMENT OF CUTOFF STRIPS ON INTERIOR OF UNIT BOX, ALSO WATERPROOFING IN PLACE ON INNER SURFACE OF BOX. FIG. 2 (RIGHT) UNIT BOX IN PROCESS OF BEING LOWERED INTO FINAL POSITION. JACKS AND CUTTING EDGE IN PLACE

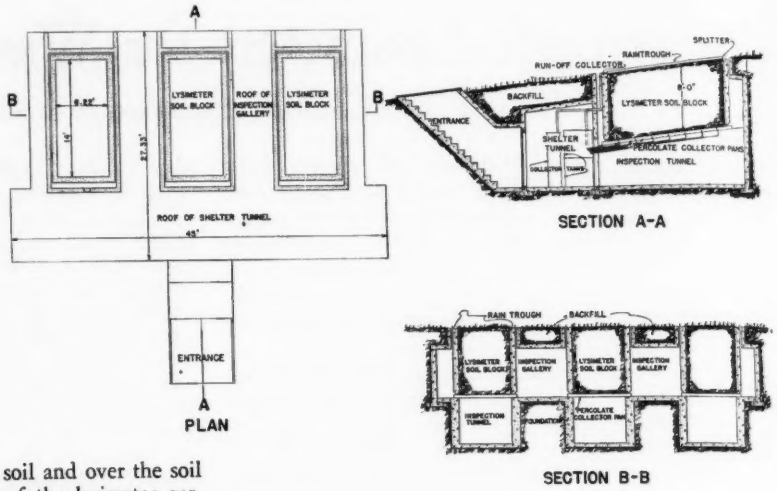


FIG. 3 PLAN AND TYPICAL CROSS SECTIONS FOR BATTERY OF WATERCYCLE LYSIMETERS

study of water movements within the soil and over the soil surface. With this method the slope of the lysimeter surface assumes the original ground slope.

Dimensions. Analysis of the various shapes of lysimeter blocks used in previous installations brought out the following points:

1 The relative dimensions of the lysimeter surface should be such that an even multiple of row-crop spacing, which is usually standardized at 42 in, might be obtained in a direction perpendicular to contours and, if possible, parallel to contours.

2 A rectangular shape eliminates peripheral concentration, decreases the length of shelter tunnel to a minimum, and provides opportunity to make the length-to-width ratio of the lysimeter unit comparable with that of typical watersheds. That is, the ratio of maximum length to average width of 23 small watersheds selected for study was 2.41. It was, therefore, decided that a length-to-width ratio somewhere between 2 and 2.50 would be most suitable for use on the lysimeters.

3 Any surface drainage area whose surface is a plane and whose sides converge will receive peripheral concentration of flow over the lower portion of the area, thus introducing the possibility of accelerated erosion over this portion of the drainage area and also unpredictable effects upon run-off characteristics.

4 A square area will not be subject to peripheral concentration and will have the least periphery for a given enclosed area. It was pointed out that such an area will not be proportioned in accordance with natural flow conditions, because the average width of the plot would be equal to the average length. It appeared also that the construction expense of a battery of lysimeters, where the individual units were square, would be high, due to increased length of the shelter tunnel which was required to house collector tanks and recorders at the lower end of the lysimeter.

The decision as to the desirable depth of the isolated soil block also required study of prevailing conditions. It was decided that the lower surface of the isolated block should be below the solum, namely, the true soil as developed by soil-building processes, and within the zone of slightly weathered rock. Within the solum pore spaces are small and numerous, thereby increasing retention of water through surface tension, which creates the familiar "sponge effect" and interferes with the free drainage of the block of soil. Within the rock the interstices are assumed to be large and drainage tends to be free. An analysis of Coshocton conditions led to the conclusion that a depth of 8 ft would, for most hillside conditions, place the plane of drainage within the slightly weathered rock. For comparability between individual lysimeters it appeared advisable to keep the depth of all units consistent at 8 ft.

With a given depth and a close range of given length-to-breadth ratio, the problem of selecting the proper surface area for the lysimeter units was simplified. Other installations studied ranged in size from flower pot dimensions to as much as 16.5 ft square. It appeared that the cost of materials for a battery of lysimeters would increase with the size of the individual units, although not in direct proportion. Due to the predetermined depth, it appeared that construction difficulties would vary inversely with the surface area up to a certain point, and that beyond this point the construction difficulties would increase with area. It was recognized that since the junction between the soil block and the retaining walls represented a plane of possible weakness, the ratio of area to periphery should be increased as much as possible. Calculations showed that a box 14 ft long and 6.22 ft wide would have, in the long dimension, exactly four row spaces of 42 in each, an area of 2 milacres, a ratio of surface area to peripheral length of 2.15, and a ratio of length to width of 2.25; and that a box 9.9 ft long and 4.4 ft wide would have, in the long dimension, three row spaces of 40 in each, an area of one milacre, a ratio of area to periphery of 1.52, and a ratio of length to width of 2.25. Since it was also recognized that the accuracy of the lysimeter unit in general would increase with area, it was decided to select the surface area of 2 milacres with a length of 14 ft and width of 6.22 ft.

The use of three individual lysimeter units per battery was selected, upon the recommendation of the Ohio Agricultural Experiment Station, as being the most practicable way of disclosing any discrepancies which might result from inherent differences between the selected soil blocks. Since it did not appear practicable to attempt to build the three units with connected sides in grid fashion, it was decided to keep the space between individual units at a minimum, in order that the length of shelter tunnel might be reduced. It was decided that intervening space of 6 ft between adjoining soil blocks would be sufficient to permit the enclosure of each of these blocks without disturbing either of the others.

Basic Construction Method. The method by which vertical walls were to be placed around the individual blocks

of soil was of primary importance in determining the basic design of the entire lysimeter unit. Three methods were considered in the original selection of this construction procedure.

1 It was proposed that the earth be excavated to form a vertical bank on each of the four sides of the block of soil to be isolated, and that concrete walls be poured against these banks. This, however, did not appear to be practicable from a construction standpoint, because of the possibility of the bank caving before or during the process of pouring the concrete.

2 It was also suggested that the block of soil might be isolated by driving vertical sheet piling precast of some permanent material around the outer edges of the block. It appeared that it would be difficult to accurately perform this operation without expensive pile driving equipment and to seal the finished wall against leakage.

3 The third method proposed that a box having four walls with a steel cutting edge at the bottom of each of the walls be constructed above the surface of the soil to the desired dimensions and that this box be lowered by removing the soil from the outside in such a manner that the box would descend when weighted. This method was accepted as being the most usable for prevailing conditions.

Unit Box with Component Parts. The design of the standard unit box which was to be built of reinforced concrete was subjected to a detailed stress analysis, in order that the box might successfully withstand the following load conditions: (1) Full hydrostatic head on the interior of the box with no backfill on the outside, (2) overhang when the box was supported on points such as stones under the edge or jacks placed at each end, (3) overturning about any edge, (4) temperature and shrinkage stresses within the concrete walls, and (5) complex stresses at the four corners of the box resulting from strain of the sidewalls.

A very important feature of the design was the elimination of the vertical seepage plane, which normally occurs between an earth fill and the vertical face of a concrete wall, by surrounding the block of soil with four steel cutoff strips, or "piston rings," which would extend both into the concrete wall and into the soil block, thus breaking the path of vertical seepage at four points (Fig. 1). These strips consist of flat pieces of steel $\frac{1}{8}$ in thick by 3 in wide, which are inserted in horizontal grooves $1\frac{1}{2}$ in deep on the inside of the concrete walls, and extend $1\frac{1}{2}$ in into the soil block. These steel cutoff strips were placed after the unit box had been lowered into final position.

Waterproofing of the concrete walls was essential to avoid a nondeterminable loss of moisture through seepage. The U. S. Bureau of Standards recommended coating the inner walls of the boxes with creosote, which would penetrate into the pores of the concrete, then covering with a coat of hot tar or asphalt to seal the surface (Fig. 1).

To lower the boxes most efficiently it was necessary to equip the lower edges with a steel cutting edge (Fig. 2). The 8-in sidewalls at the lower edge are decreased in width through a 45-deg bevel to a 4-in edge resting in 4-in steel channels with the web of the channels down and parallel to the lower surface of the soil block. These channels are anchored to the concrete by bolts welded to the channels and imbedded in the concrete sidewalls. The cutting edge itself consisted of a 3x3x$\frac{3}{8}$-in angle with one leg bolted to the channel and the other pointing downward to serve as a knife edge and trim the soil block as the box was lowered.

The upper edge of the surface area of the isolated soil block is defined by a sheet metal strip called a splitter (Fig. 3). This is made of 12-gage galvanized iron and is set flush with the edge of the soil. The two side edges of the lysimeter surface are defined by the inner edges of rainfall measurement troughs, also constructed of 12-gage galvanized sheet metal (Fig. 3). These troughs are 8 in wide and 3 in deep at each side and have a V-bottom. Since these troughs rest on the top of the sidewalls, the rain falling into them drains to the lower end where it is transferred through galvanized iron pipes into the collector tanks in the shelter tunnel. A recording rain gage of the Fergusson weighing and recording type, and a standard 8-in rain gage are also operated in connection with each battery of lysimeters to provide standard rainfall measurements.

A runoff collector was designed to rest on top of the vertical wall at the lower end of the lysimeter (Fig. 3). This trough of 12-gage galvanized sheet iron is 8 in wide, with the bottom sloping slightly forward across the 8-in width but inclined from either side of the lysimeter box to the center, so that runoff water entering the trough drains through a galvanized iron pipe to a collector tank in the shelter tunnel. The runoff waters enter the collector over a weir plate which is set level and flush with the surface of the soil. The runoff collector is covered with a removable sheet metal lid with the inner edge directly over the runoff weir, to define the lower edge of the isolated block

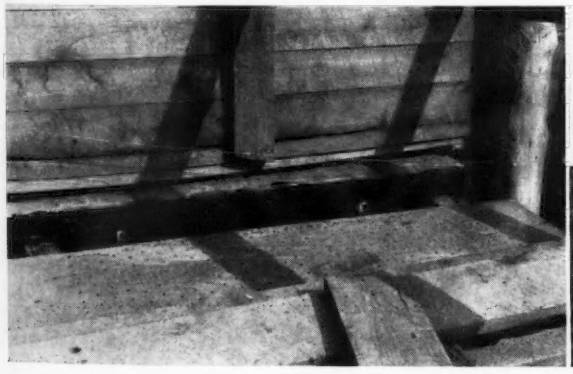


FIG. 4 (LEFT) PLACING OF PANS UNDER WATERCYCLE LYSIMETER BOX, SHOWING $\frac{1}{2}$-IN HOLES ON 2-IN CENTERS IN UPPER PLATE OF PANS AND ASPHALT CEMENT USED AS SEAL BETWEEN INDIVIDUAL PANS. FIG. 5 (RIGHT) GENERAL VIEW OF COMPLETED BATTERY OF WATERCYCLE LYSIMETERS

and to prevent rain and debris from falling into the runoff collector.

The unit which collects the percolate waters draining through the soil block presented a difficult problem of design which was controlled by the following criteria:

1 It must collect all percolating waters from the block of soil without creating appreciable resistance to their emergence and, if possible, without accelerating the drainage.

2 It must support the concrete box and the block of soil within the box.

3 It was necessary to install this unit without disturbing the soil in the box.

Various plans were considered and the following design was selected: Steel pans (Fig. 4) 2 ft wide, 5 in deep and 7 ft 7 in long were designed to be placed as transverse beams across the bottom of the lysimeter box with each end of the pans resting upon concrete walls, the box and soil block in turn resting upon the pans. The 7-ft 7-in dimension of the pans is perpendicular to the long center line of the box and the 2-ft dimension is parallel to this center line. The sides of each pan are made of 3x5x½-in steel angles with the 5-in leg pointing downward. The top of the pan is a 5/16-in steel plate with ½-in holes spaced on 2-in centers in grid formation over the plate. Each end of the box consists of a 5/16-in steel plate and the bottom is of the same material. Each pan is drained by a ⅜-in brass street ell at the lowermost point. The 5-in leg of each of the side angles of the pan was cut in such a way that the bottom lies in a flat V, so that all drainage waters entering the pan move more readily to the outlet at the center of the pan. Eight of these steel pans were required side by side to completely cover the bottom surface of each lysimeter box. The adjoining edges of the pans are sealed against vertical leakage by a layer of asphalt roof cement between them. The concrete walls which support the eight pans, the concrete box, and the earth block, were set with inner faces 6 ft apart. These also serve as sidewalls for a tunnel used for inspection purposes (Fig. 3).

Instrument Room and Inspection Galleries. The entire surface area surrounding the three lysimeter units in a given battery must be devoted to the same crop and tillage practices as the lysimeter. This practice helps to eliminate border effect and makes each box more nearly comparable with the small adjacent watershed. This condition necessitated the placing of all collector tanks and recorders in covered rooms below the ground surface. In order that it might be possible to periodically inspect for leaks the outside of each lysimeter box, it was necessary to build galleries around each unit of the battery (Fig. 3). These galleries are accessible from the inspection tunnels beneath the percolate collector pans. The floor of each gallery consists of a concrete slab laid on the natural rock and level with the top of the walls which support the percolate collector pans. A shelter tunnel (Fig. 3) was designed for the housing of all collector tanks and measuring equipment. The inner dimensions of this tunnel were 7 ft 9 in wide, 9 ft 6 in high, and 44 ft long, with the center line parallel to the front face of the three lysimeter units, and with the outer face of the backwall of the tunnel set 7 in from the outer face of the boxes. The floor of the shelter tunnel was set level with the floor of the inspection tunnels at the point where they enter the shelter tunnel. The floors of the inspection and instrument tunnels are drained by standard 4-in sewer tile which carry drainage waters some distance downhill from the lysimeter battery. The entrance to the shelter tunnel (Figs. 3 and 5) from the outdoors

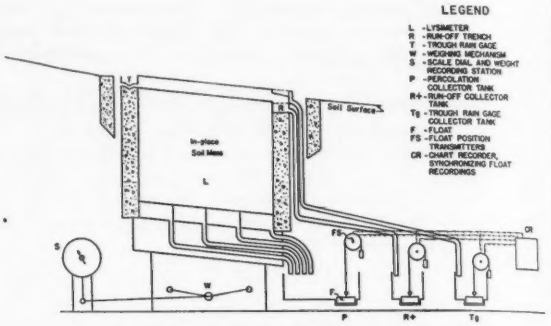


FIG. 6 SCHEMATIC DIAGRAM OF WATERCYCLE LYSIMETER

is through a stairway laid on a 45-deg slope, with a doorway parallel to the surface of the ground at the top of the stairway, and a vertical door at the bottom of the stairway entering directly into the shelter tunnel. These two doors form an air and temperature lock which helps to prohibit changes of temperature and humidity inside the shelter tunnel and inspection galleries.

Measuring Equipment. The collector tanks for rainfall, runoff, and percolate were designed to have one-tenth the surface area of the actual lysimeter or of the rain troughs as the case might be, thus giving a depth of rainfall, runoff, or percolate in the tanks exactly ten times that which actually occurs. The horizontal surface area of the lysimeter is 2 milacres or 87.12 sq ft, and the area of the runoff and percolate collector tanks is 8.712 sq ft each, with a diameter of 3 ft 4 in. The horizontal surface area of the two rain troughs is 18.72 sq ft, and the area of the rainfall collector tank is 1.872 sq ft, with a diameter of 1 ft 6½ in. The rainfall and runoff collector tanks were designed 6 ft deep inside to accommodate 7 in of rainfall or runoff. The depth of the percolate collector tanks was made 2 ft 9 in to accommodate 3 in of percolation. It is planned to install covers on each of the tanks as soon as the rate measuring instruments have been installed, in order to reduce evaporation losses from the tanks.

Since rainfall, runoff, and percolation must be measured in quantity and time of occurrence, it was necessary to design rate measuring mechanisms. A schematic diagram of this arrangement is shown in Fig. 6. To accomplish this a recess is provided in the bottom of each collector tank to accommodate a standard 10-in water stage recorder float. This float, through the usual combination of perforated tape, weight, and sprocket wheel, actuates a specially designed mercury contact switch. Each of these switches is connected to two pens of a 20-pen recorder so that one pen will make a mark on the chart for each one-hundredth inch and the other for each one-tenth inch of change in water level in the collector tanks. Examination showed that rates of rainfall and runoff will at times be so great that the marks made by the one-hundredth-inch pen would be so close together as to be undistinguishable. The design of the mercury contact switch is of such nature that contact is make-and-break, thus avoiding the possibility of a long continuing flow of current in case the sprocket wheels should come to rest while there is an electrical contact. The nine rainfall, runoff, and percolate collector tanks at each lysimeter battery require 18 of the 20 pens operating on one chart. The other two pens are reserved for time-synchronizing purposes.

Weighing Mechanism. The lysimeter measuring mechanisms as described up to this point are capable of obtaining

a complete record of rainfall, runoff, and percolation in both rate of occurrence and total amount, but it is possible to obtain reasonably accurate values for infiltration and evapo-transpiration only by mathematical differences over long periods of time. Too, this determination would reveal only total quantities and would not express rates of evaporation and transpiration losses. It was, therefore, decided to secure a weighing mechanism which would make a continuous record of the rate of change of weight of a lysimeter. In making a search for this weighing mechanism it was necessary to establish the following basic requirements: (1) The scales must support a gross weight of approximately 60 tons, the sum of concrete walls, soil, sheet metal, and steel pans. (2) The weight of 1/100 in of water over the surface of the lysimeter is 4.53 lb. Since other measurements are made to the nearest one-hundredth inch, it is desirable to approach this same accuracy with the weighing mechanism. Measurement of weight to the nearest 5 lb was, therefore, specified. (3) A general study of soil moisture information indicated that the range of change in weight of the lysimeter soil block might be as great as 20,000 lb and this was accordingly selected as the range through which the 5-lb degree of accuracy must apply. (4) The recording mechanism was required to print the weight, as based on an assumed datum, every 30 min, with an automatic switch to make recordings at 10-min periods during storms.

After considerable collaboration with scale manufacturers a special scale was developed, using the lever and pendulum principles, to meet the above requirements. Dead weight below the expected range of weight variance was eliminated by counterbalances.

Selection of the Site. To properly locate a lysimeter battery adjacent to a typical small watershed, the problem was to select a site representative of slope, soil, and erosion conditions. To determine average slope a map of the watershed was made to a scale of 1 in equals 50 ft, with 2-ft contours, from which were measured factors for use in the following formula:

$$\text{Average Slope} = \frac{100 \times \text{Contour interval} \times \text{Total length of contour}}{\text{Area of watershed in square feet}}$$

An area with average slope was then selected just outside the drainage divide. In laying out the boxes the centerlines were laid perpendicular to the selected slope, which was as nearly plane as could be found. Average conditions of soil and erosion were located from detailed field surveys of the small watershed and adjacent area.

CONSTRUCTION

Concrete Box. Construction of the lysimeter boxes was begun by laying upon the selected site 2-in planks as a protection to the surface soil and to evenly distribute the weight of the concrete box upon the soil. The steel-cutting edges were set in proper location and blocked in place parallel to the slope of the ground. The inside forms were then built and braced. Forms for the grooves in which cutoff strips were to be placed consisted of ¼x1½-in beveled wooden strips attached to the inside forms at 1-ft intervals, four to each end and side. These strips were then covered with 26-gage galvanized sheet metal and were extended from the ends of the strips through the outside forms by ¼x3-in steel plates. The strips on the sides of the box were not continuous but were broken at the center and overlapped so that they could be set horizontal. The reinforcing steel and outside forms were placed and blocked into position. The concrete was poured, using a 1:2:4 mix with only sufficient water to make the concrete workable, in order to obtain dense concrete. As the concrete set, care was taken to loosen the ¼x3-in steel plates and to remove them within 12 to 36 hr after the pouring of the concrete. After removal of the forms, the waterproofing was applied. The finished and waterproofed inside corner of a box, with four grooves for cutoff strips on each side, may be seen in Fig. 1.

Excavation. The shelter tunnel excavation was of open pit type and was followed by driving of the inspection tunnels. The entrance to each inspection tunnel had a 7-ft 9-in clear opening between posts (Fig. 7). This permitted passage of the steel pans which were 7 ft 7 in wide. The tunneling operation was carried on with the use of jacks, picks, shovels, and a pistol-grip paving breaker. The roof of the tunnel was shored by plank 3x6 in x 6 ft, the 6-ft length being necessary to permit pouring foundation walls and later to remove the shorings. Concrete foundation walls 1 ft thick to support the lysimeter box were then placed, the inside edge being 3 ft from the centerline of the inspection tunnel. The tops of these foundations slope the same as the soil surface and are 8 ft 5 in below the surface.

FIG. 7 (LEFT) METHOD OF DRIVING AND SHORING INSPECTION TUNNELS. FIG. 8 (RIGHT) A BATTERY OF WATERCYCLE LYSIMETERS UNDER CONSTRUCTION. THE THREE SEPARATE BOXES HAVE BEEN LOWERED AND RAIN TROUGHS PLACED ALONG EACH EDGE, BUT RUNOFF COLLECTORS AT LOWER END OF BOXES HAVE NOT BEEN PLACED. STEEL AND FORMS ARE IN PLACE FOR POURING TOP OF SHELTER TUNNEL WHICH PROTECTS ALL COLLECTOR TANKS AND RECORDING INSTRUMENTS

The pans were joined together by lugs on a runway platform in front of each tunnel. Asphalt roof cement was placed between them, as shown in Fig. 4. To the front pan was attached a 3-in angle to assist in cutting the lower surface of the soil block to a smooth plane which the tops of pans slid against as they were jacked into place. The planks were removed as pans moved forward to take their place.

Lowering of the Boxes. A cable was attached to each corner of the box and anchored, each cable having a turnbuckle attachment to aid in keeping the box plumb. To each end of each box two heavy angles were attached and used as lifting points. The boxes were raised on jacks and the planks removed. The boxes were then lowered into the ground keeping the original slope to the top of the box. To keep this correct slope, the four jacks were released uniformly at all times. To check the exactness of the position while lowering, frequent elevations were taken on each corner of the box to determine its exact position at all stages of the lowering operation.

Two jacks placed under one end of a box, and also the excavation around all boxes in one battery may be seen in Fig. 2. The soil was excavated from around the outside of all boxes down to the bottom edge of the lysimeter boxes. The 3-in angle cutting edge previously described helped in cutting a smooth surface just below the inside edge of the box. This excavation proceeded inch by inch as the box was lowered.

Soil samples were taken on all sides of each box at 6 to 18-in vertical intervals during the lowering of each unit and these samples analyzed to obtain a profile of the soil within the box.

When the lowering operation was almost completed the 3-in angles were removed from the bottom of the box. A layer of asphalt roof cement was placed on the back of the 4-in channel and the box was then lowered onto the pans, the asphalt cement forming a water-tight seal between the pans and the walls of the lysimeter box.

With the boxes in final position steel cutoff strips, $\frac{1}{8}$x3 in, were driven through the corners of each box and followed the grooves left in the inside of the box walls. After these strips were driven into final position, the holes shown in the corners of each box (Fig. 1) were closed with roof cement and concrete.

The scale was placed under one unit of one battery. A concrete foundation supports a steel frame 14 ft in length and 5 ft 8 in wide, with the bottom of the frame level and the top slope conforming with the slope of the box under which it is placed. The frame was assembled in front of the tunnel, rolled into position under the box, then raised up until it came in contact with the pans. The lysimeter box, earth, pans, and steel frame were then jacked upward off the foundation, the pedestals, levers and cabinet placed and the box lowered until the scales carried the weight. The scales were tested, following their installation, by the U. S. Bureau of Standards. While making these tests the site was protected against wind action by a tent cover. Standard calibrated weights were used on the top of the lysimeter box and the resultant scale reading noted. The weights used weighed 50 lb each, a total of 5,000 lb being applied in this manner for each test.

Shelter and Inspection Tunnels. Shelter and inspection tunnels were built in accordance with the general layout shown in Fig. 3, and in Fig. 8 may be seen the house in position ready for pouring the concrete roof, the three boxes in final position, and the rain trough attached to each side wall ready for placing of the runoff collectors. Two ventilators were placed, one at each end of the shelter house as shown in Fig. 5. Upon completion of the shelter and inspection tunnels soil was placed back over top of the tunnels and galleries.

Placing of Equipment for Collection of Data. On top of the vertical wall at the lower end of the lysimeter box the runoff collector was mounted with a 2-in plank between it and the concrete to permit adjustment. Rain troughs and splitter were mounted on top of the concrete side and upper walls using a coating of plastic to prevent seepage. Galvanized iron pipes were attached to the ends of the rain troughs and runoff collector to carry the water into the shelter tunnel and to corresponding rainfall and runoff collector tanks. A $\frac{3}{8}$-in heavy brass pipe was attached to each of the eight percolation pans to carry the water to a central collecting tank for each box.

CONCLUSION

These lysimeters are a distinct departure from previous installations in breadth of scope and in details of design. Improvements in both details of design and construction procedure are discovered and noted from time to time. It is suggested for example, that the scale used on future installations will record in inches of water rather than in pounds and that some changes be made in placing future percolate collector pans. Two batteries of the type described in this paper have been completed with the exception of the installation of recording mechanisms on rainfall, runoff, and percolate collector tanks. The third battery is under construction. The data collected both from daily readings of the various collector tanks and from records of the scale, while not sufficient in extent to establish any trend for the experiment, do indicate that the lysimeters are properly functioning in accordance with the plans of their design.

This project is a cooperative undertaking between the branch of research of the U. S. Soil Conservation Service and the Ohio Agricultural Experiment Station. Recognition is also made of collaboration with the departments of civil and agricultural engineering of Ohio State University and with the Ohio Agricultural Experiment Station in the planning and design of these lysimeters.

Scioto-Sandusky Conservancy

THE SCIOTO-SANDUSKY Conservancy District is managed by a board of three directors of which Prof. C. E. Sherman, department of civil engineering at Ohio State University, is president. The other members are J. V. Vanmeter of Chillicothe and A. J. Allman of Tiffin.

Prof. Sherman, who has studied control of Ohio streams for many years, has made this statement on the proposed conservancy project:

"Pre-glacial maps show that the upper Scioto formerly flowed into Lake Erie; and it is easily possible now to turn upper Scioto waters into the Sandusky by a shallow cut through the low divide. A glacial moraine forms this divide, and with another parallel moraine ten miles north, forms a large basin in which flood waters can be stored and fed through the cut into either river as desired. This peculiar possibility occurs nowhere else on the divide between Lake Erie and the Ohio River, and the lake thus proposed offers the most attractive conservation pool in the state. In connection with dams proposed on lower tributaries, it protects the valleys of both streams against both floods and droughts."

Water conservation and flood control on the Scioto and Sandusky as proposed by the new board of directors of the district, is entirely independent of the much-discussed nine-foot waterway connection between lake and river.—*From the Engineering Experiment Station News, Ohio State University (February 1938).*

What Agricultural Engineers Are Doing

FROM THE U. S. BUREAU OF AGRICULTURAL ENGINEERING

R. L. PARSHALL of the Division of Irrigation, Bureau of Agricultural Engineering, reports that the test apparatus to demonstrate the working principle of the acre-foot integrator for measuring stream flow has been put into operation and at this time the possibilities of developing a practical instrument appear to be promising. This instrument, when built, will indicate the time in hours and minutes, on an ordinary clock dial; a revolving indicator will show the rate of discharge in second-feet, either for a standard weir or Parshall measuring flume for any particular size; and on a series of dials will indicate the total acre-feet as a summation of the flow.

* * *

Tests made by A. A. Young during the past year in the vicinity of Pomona, Calif., indicate that the rate of evaporation from a screen-covered evaporation pan 2 feet in diameter equalled almost exactly that from a 12-foot pan without screen, showing that the screen-covered pan is suitable for direct measurement of reservoir evaporation without using a reduction coefficient. Somewhat similar results were obtained from the same type of pan in the Imperial Valley at Bard, Calif., indicating that this pan may become useful in desert as well as coastal climates.

* * *

Data compiled by Leslie Bowen at the Scottsbluff, Nebr., experiment station during the past season on use of water by corn and beans from different depths of soil, indicate that the beans drew 52.2 per cent of the water they used from the first foot, 22.8 per cent from the second, 16.3 from the third, and 8.7 from the fourth foot. For corn the corresponding percentages were 68, 17.2, 9.8, and 5.

* * *

Karl Harris was called upon by members of the St. David (Arizona) Irrigation District to assist them in the solution of problems connected with assessments against landowners for construction of a dam to impound irrigation water, there being a conflict between ownership of land and ownership of water stock. Mr. Harris recommended that the district do the work and that assessments be made on an acre basis. This recommendation was adopted and work on the dam, which had been suspended because of the conflict, was resumed.

* * *

Under the snow survey and irrigation water supply forecasting project, mimeographed reports of snow measurements as of about January 1, on snow courses of the western states network were prepared and distributed to cooperators and other interested parties, including railroad and chamber of commerce officials. Weekly reports of conditions in the various watersheds, for winter sports, were prepared and broadcast. Considerable use was made of short-wave radio, in Oregon, for reception of snow observations from isolated observers, and in connection with routine matters relating to snow survey work and snow sport information. R. A. Work made arrangements for a Universal news reel photographer to accompany a snow survey crew to Seven Lakes this spring if snow conditions are favorable for good pictures. Mountain fever vaccine was distributed to 65 cooperators or field snow survey observers, at their request.

* * *

Despite unfavorable weather conditions, the January excavation and embankment production of the central district drainage camps totaled ¾ million yards. This is the highest January yardage production since the establishment of the CCC drainage camps.

* * *

Dr. Imre de Razso, assistant professor in the Royal Hungarian Academy of Agriculture at Magyarovar, Hungary, spent a few days in Washington discussing with various engineers of the Bureau matters of mutual interest in agricultural engineering. He left Washington February 13 for an extended trip throughout the United States to visit various agricultural experiment stations, rural electric projects, and farm machinery manufacturers.

* * *

G. A. Cumings attended the annual meeting of the Association of Southern Agricultural Workers at Atlanta, Ga., February 2 to 4. He also conferred with several implement manufacturers and representatives of cooperating experiment stations relative to fertilizer placement research. Experiment stations, in their endeavor to use improved methods of fertilizer application in field experiments, recognize the importance of agricultural engineering in developing suitable equipment. Improved fertilizer machinery for cotton is now on the market in the two-horse and tractor types, but fertilizer placement equipment for the single-row walking type machines, although available in several new designs, is still in the experimental stage.

* * *

At Davis, Calif., construction of a four or six-row, single-seed sugar beet planter is under way. This planter will be used to test the method of planting in connection with mechanized thinning on field plots this spring.

* * *

A seed metering device directly attached to the disk furrow opener for a beet drill has been built by E. M. Mervine. The purpose of the device is to maintain a steady flow of individual seeds delivered so close to the furrow that they are placed at regular intervals in the soil. This is accomplished by having seed cups directly attached to the rotating disk which picks up its seeds from the reservoir between the disks. Its simplicity apparently makes it valuable for other seed.

* * *

On January 28, O. K. Hedden left Toledo, Ohio, by truck with experimental burning equipment for Florala, Ala., to assist in preparation for experimental work on the control of the white fringed beetle.

* * *

A further analysis of the apparent gravity determinations from samples taken by the division of mechanical equipment at the Prattville Field (Alabama) shows that 1936 and 1937 data are much the same, although a smaller number of samples were analyzed in 1936. E. D. Gordon has found that the data for the two years have the following points in common: The apparent specific gravity determination from samples taken after planting have a better inverse correlation to the yield of seed cotton than those taken after harvest; the apparent specific gravity of all the plots studied averaged lower after harvest than after planting, the spread ranging from 0.06 to 0.08 apparent specific gravity; considering the statistical trend which the data produce, zero yield of cotton would be obtained when the apparent specific gravity of the soil approaches very nearly that of the parent rock; the slopes of the lines of trend for the "after planting" data are very nearly the same, however, the average yield for 1936 was lower than for 1937.

* * *

Max J. LaRock, who has represented the Bureau on the cooperative investigations of farm housing at Madison, Wisconsin, has resigned effective March 2, to become extension agricultural engineer for the University of Wisconsin. E. G. Molander left February 20 for Madison to study the data so far obtained and assist in the preparation of a report of the work.

* * *

On January 28, 29, and 30, Messrs. Wallace Ashby, S. P. Lyle, and T. A. H. Miller attended a conference at Atlanta to select plans for the farm building plan exchange for the southern states. Representatives from the agricultural engineering departments of the following states were present: Alabama, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Virginia. The agricultural engineers were assisted in the selection of farmhouse plans by home economists from Alabama, Florida, Georgia, South Carolina, Tennessee, and the U. S. Department of Agriculture.

Contributions Invited

All public service agencies (federal and state) dealing with agricultural engineering research and extension, are invited to contribute information on new developments in the field for publication under the above heading. It is desired that this feature shall give, from month to month, a concise yet complete picture of what agricultural engineers in the various public institutions are doing to advance this branch of applied science.—EDITOR.

NEWS

Your Summer Vacation and the ASAE Meeting

By J. Dewey Long

IT IS time for agricultural engineers to think ahead to their summer vacation and ASAE annual meeting at Asilomar (Resort-by-the-Sea), Pacific Grove, California, June 27 to 30. In order to receive the greatest return for the time and money invested, a certain amount of detail planning is necessary. The committee in charge of local arrangements will provide several aids to such preliminary planning during the next three months, and any Pacific Coast agricultural engineer will be glad to offer advice or suggest roadside items of interest in his specialized field or geographical area.

Based on past experience it is anticipated that a large percentage of members will arrive at the meeting by automobile. For such members route information will be available. Many perhaps will prefer to drive west by one of the southern routes and return by a central or northern highway. The personal experiences of agricultural engineers who have made transcontinental automobile trips during the past few years indicate moderate expenses of $8 to $10 daily for two people and automobile, and a conservative daily distance of 400 miles, except when lengthy stops are made. By anticipating somewhat the character of the country ahead each day, and making inquiry of gasoline service stations and other tourist information services, comfortable and reasonable cost accommodations may be secured along any of the main travel routes. With very few exceptions the character of the roads through the desert and mountain regions have been made safer for automobiles maintained in good driving condition than many city streets. Certain of the western states have established border patrol stations on the main highway. In California, the state department of agriculture maintains such stations as agricultural inspection departments, and tourists are requested to submit to inspection to insure that a certain few agricultural products likely to carry insect or disease pests may not be brought into the state.

Certain of the automobile stage lines plying between the west coast and midwestern cities offer very attractive rates. Some of the newer stages are sleeper cars with ingenious design features contributing to comfortable overnight travel which intrigue an engineer. Other trips are scheduled for overnight stops at comfortable hotels, and an appreciable number of the hardier travelers select the less comfortable, but also less expensive, mode of riding day and night in the standard stages.

Western railroads have made improvements in service and reductions in charges during recent years which are very attractive. Comfortable streamline trains travel between Chicago and San Francisco in a day and a half. So popular is this service despite the extra fare that reservations must be made several weeks in advance. Three classes of accommodation are provided on the standard trains: 1st class, entitles the traveler to secure pullman car reservations (air-conditioned); 2nd class, entitling one to procure tourist car accommodations, and 3rd class, providing chair car seats. Certain trains are designed as economy trains. On one such within the past month I was pleasantly surprised with the comfortable new equipment and with the adequate breakfast which cost 25 cents. It is quite possible that arrangements will be made for special pullman cars from Chicago to a siding within two blocks of the grounds where the meeting is held. Details relating to this possibility will be mailed from the Secretary's office in due course.

Air travel becomes increasingly popular, and for busy people offers definite economies.

Arrival at Asilomar drops the traveler into a restful, comfortable atmosphere. This is a simple, family-type resort into which the agricultural engineers will settle comfortably for fireside chats and get-acquainted groups without bothersome observance of trifling social conventions. The entire resort has been reserved for the agricultural engineers during the four days of the meeting, and it is anticipated that many will wish to remain for a few days after the meeting for relaxation and sight-seeing as so many did at Estes Park two years ago.

Accommodations at the resort may be classed in four major groups, from excellent hotel type rooms to the long houses where cubicles opening either side of a long central hall remind one of the pioneer western hotel. Regular hotel rooms and automobile tourist cabins of a good class are available within a radius of six blocks of the Asilomar gates, and reservations for these may be made through the resort management. Resort rates are moderate, and a special rate has been granted for those maintaining their reservations throughout the convention.

The question of clothes will be troublesome to some. It can be readily answered with informal and sport apparel, with emphasis on the latter. A moderately heavyweight wrap should be included as the summer evening chill of the ocean may cause goose pimples until one becomes acclimated. In spite of this being sunny California, it is possible for June fogs to move in which remind one of the stories of London streets. (In the event one does appear the lighthouse, less than a mile up the coast, will present an interesting spectacle.) Normal California weather is anticipated, of course, but a change to warmer clothes may prove desirable in case some of the "unusual climate" should appear.

In addition to selecting an "air-conditioned" meeting site, which may recall pungent memories of certain sweltering meetings of recent years as contrast, the local arrangements committee have arranged for one outstanding event of general interest. The

(UPPER LEFT) AGRICULTURAL ENGINEERS — WALTER WEIR, RUSSELL PERRY, AND JIM FAIRBANK — CONSIDER THE MARINE VIEW FROM ASILOMAR. (LOWER LEFT) LOCAL COMMITTEE CHAIRMAN W. W. WEIR STUDIES THE SOIL CONSERVATION FEATURES OF A WHITE SAND DUNE NEAR ASILOMAR. (RIGHT) THE CENTRAL DRIVE AT ASILOMAR, WITH THE COBBLESTONE DINING HALL IN THE BACKGROUND

A DEL MONTE GOLF COURSE LYING ALONG MONTEREY BAY, NEAR ASILOMAR

lowest ocean tide of the year is scheduled to occur on the first day of the meeting, permitting one to walk out among marine life covered at all other times. A competent lecturer is being secured to discuss this phenomena and the sights it uncovers, and visits to the Stanford University marine station and trips in a glass-bottomed boat are being arranged for the natural history students among the members.

Golf, swimming (pool or ocean beach), volley ball, tennis, fishing (both deep sea and mountain stream), hiking, games (backyard, deck, and parlor), and contests are being planned by the local entertainment committee. Automobile trips are being arranged to local points of interest, including the old missions of Monterey and Carmel, the historic old houses and public structures of the Peninsula, the internationally famed social resort-hotel Del Monte, the colorful (and odoriferous) fishing fleet and sardine canning industry, the well-known 17-Mile Drive, the drive along the recently completed highway hanging above the rugged coastline to the Big Sur country, and to Pfeiffer Redwoods State Park with its grove of the awe-inspiring California big trees. The general social program of past ASAE annual meetings will be followed, with definite local color promised by the entertainment committee.

In spite of its entertainment and activity possibilities, Asilomar is restful. Members wearied by meeting movement may relax in comfortable lounges and gaze meditatively at the ever-changing panorama of the sea, framed by pine trees and white sand dunes. The resort management in some of their publicity releases to the newspapers recently suggested that the site had been selected by the agricultural engineers because of its freedom from agricultural problem worries; the site is too sandy to grow any crop, and what forage grows in spite of this handicap is eaten by deer.

G. D. Jones Honored

AT ITS annual meeting at Harrisburg January 18 the Pennsylvania Potato Growers' Association signally honored G. D. Jones, agricultural engineer and patent counsel of The Cleveland Tractor Company, by awarding him the Association's gold charm in recognition of meritorious service to the potato industry through marked contributions toward increased production, improved quality, and lower costs.

Mr. Jones has been a member of the American Society of Agricultural Engineers since 1918. He has served on many committees, and at present he is a member of the committee on research, and chairman of the Society's new committee on the energetics of the biology in agriculture. Besides being a successful inventor, Mr. Jones for a number of years has been an ardent student of some of the more technical aspects of soil tilth and soil management, especially from the standpoint of the electrical phenomena involved in basic soil and plant behavior. Some of his contributions reflect his original thinking and his pioneering researches in this fundamental area.

Although the gold charm has been available for four years, this is the first year it has been awarded. The charm symbolizes knowledge, vision, dependability, and integrity, characteristics which George Douglas Jones typifies to an unusually high degree. The American Society of Agricultural Engineers is honored by the award of this charm to one of its prominent members.

Wirt Addresses Kansas Farmers

FRED A. WIRT, agricultural engineer, J. I. Case Company, and a past-president of ASAE, addressed a large audience of Kansas farmers attending the annual Farm and Home Week at Kansas State College, February 11, on "The Development of Farm Machinery and Agriculture."

Farmers showed intense interest in the subject, which was presented with a view to clarifying the present American agricultural situation by interpretation of past farm problems and of the trend of progress.

Mr. Wirt covered the subject in three broad divisions dealing with (1) the production of an exportable surplus, from early colonial days, (2) the design and modernization of farm machinery, and (3) the use of foreign capital in the development of this country up to 1917.

L. J. Fletcher Honored

AT ITS 18th annual meeting held in Washington in January, American Engineering Council honored Leonard J. Fletcher by electing him treasurer for 1938. Mr. Fletcher served the American Society of Agricultural Engineers as president in 1931-32, and for the past four years he has been the Society's official representative on American Engineering Council. His election to the office of treasurer of American Engineering Council is in recognition of his outstanding service to that organization. Mr. Fletcher is assistant general sales manager of Caterpillar Tractor Company.

Chemurgic Council Changes

NATIONAL Farm Chemurgic Council has recently moved its headquarters from Dearborn, Michigan, to New York City, where it may be addressed at 654 Madison Avenue.

Carl B. Fritsche, former managing director, has returned to private engineering practice at Detroit, Michigan, but will continue to participate in Council activities.

Wheeler McMillen (Assoc. ASAE) newly elected president of the Council, succeeding the late Francis P. Garvan, will direct the executive management of the Council.

Willard H. Dow, president of the Dow Chemical Company, has been elected to succeed the late Howard E. Coffin as the Council's vice-president representing industry.

Omaha, Nebraska, has been named as the place of holding the Fourth Annual Farm Chemurgic Conference, April 25 to 27.

Agricultural Engineers to Get New Building

A NEW agricultural engineering building is one of a group of ten new major structures started at The Pennsylvania State College with ground-breaking ceremonies held February 26. The ceremony was held indoors with symbolic spading of earth taken from the ten building sites.

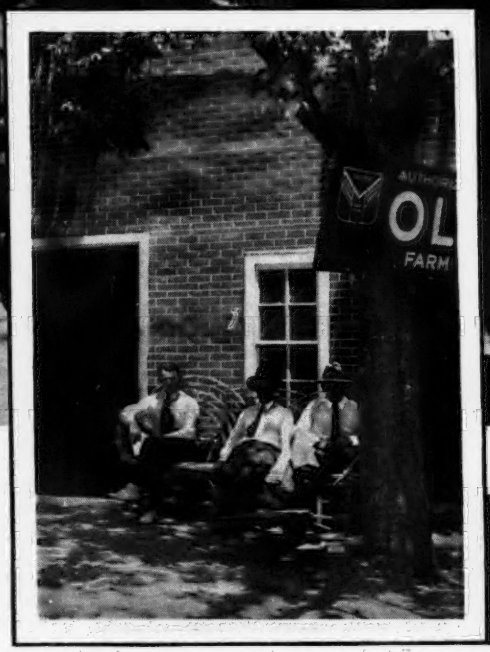
R. U. Blasingame, a past-president of ASAE, is head of the agricultural engineering department which will occupy the new building.

(News continued on page 134)

ASAE Meetings Calendar

June 27 to 30—Annual meeting of the Society, Asilomar at Pacific Grove, Calif.

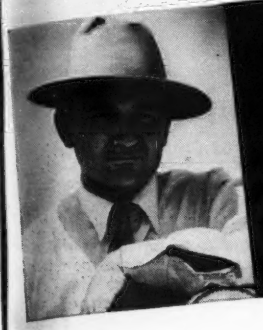
"IN OUR SECOND YEAR



(*Above*) R. L. Ferguson (*left*), Oliver blockman of Waco, Texas, congratulates Joe Pavlas, Oliver dealer of West, Texas, on his outstanding record. (*Right*) J. L. Horsak, Mr. Pavlas' partner, Frank Pavlas and Joe Pavlas stop work long enough to have their pictures taken in front of the store.

TO SELL

OUR BUSINESS HAS MORE THAN DOUBLED"



How high compression helped Joe Pavlas to sell more tractors than all the other dealers in town combined.

IF YOU want an idea of what high compression can do for your business, read this story of Joe Pavlas, Oliver tractor dealer of West, Texas. Mr. Pavlas started selling high compression tractors in August, 1935. He says:

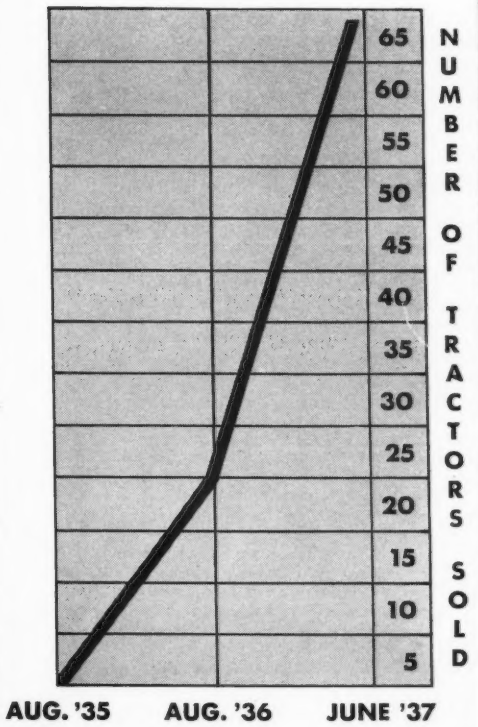
"At the end of our first year in the tractor business, we had sold 20 tractors. In the first ten months of the second year, our business more than doubled. We sold 43 tractors in the ten months from August, 1936, to June, 1937—more than all our competitors put together.

"Every tractor we have sold is a high compression Oliver 70. We tell our customers to use regular-grade gasoline.

"We have a three-man organization—my partner, a service mechanic, and me. I have handled all sales since we started in business. We have received cash for every tractor sold."

To get your share of tractor sales in your territory, talk, demonstrate and sell high compression. Write your manufacturer or blockman today for information about the latest high compression models, and also details of high compression ("altitude") pistons or cylinder heads to change over low compression tractors. And remember, a good tractor is a better tractor with gasoline. Ethyl Gasoline Corporation, Chrysler Building, New York, N. Y., manufacturers of anti-knock fluids for regular-grade and premium gasolines.

HERE'S THE RECORD JOE PAVLAS SET WITH HIGH COMPRESSION TRACTORS



MORE TRACTORS . . . *demonstrate high compression*

Student Branch News

SOUTH DAKOTA

WRITING, tearing up the manuscript, and then writing it over again, far into the night—that is what the student reporters are doing while the editor scurries helter-skelter in search of new ideas and material. The business managers nervously open the incoming mail as they wait hopefully for favorable answers to their solicitations for advertising. The South Dakota Student Branch is about to try out its wings for the first time in the field of journalism.

The publication, which will be a feature issue of the "South Dakota Agriculturist," the new magazine put out by the agricultural students at SDSC, will be entirely written, edited, and managed by agricultural engineering students. Although this issue is scheduled to appear in the month of May, the agricultural engineers are already working to have their number set a high standard for succeeding issues.

However, the Branch does not confine itself to any one activity. Plans are already complete for a display of the benefits derived from rural electrification, to be shown at the "Little International" livestock and grain show put on by the agricultural students, March 4.

The Branch now boasts of its largest membership to date. Three men have transferred to agricultural engineering this year from other divisions.—*Marvin Ellis, President.*

GEORGIA

THE Georgia Student Branch of the American Society of Agricultural Engineers held its regular meeting Monday evening, February 7. The meeting was called to order by the president, LeRoy Reaves. In a short business session plans were discussed for a dance in the near future.

Walter D. Hemker of the Westinghouse Electric Company spoke to the Branch on "Rural Electrification." He said that rural electrification is not just extending lines into rural communities, but a means toward an end, by which the farmers can get the conveniences that electricity brings. He discussed the two methods of bringing lines into the house. The methods are the fuse-box entrance and the automatic circuit-breaker entrance. Mr. Hemker said that electricity is justified more by being a labor saver than an income producer. He concluded his talk by mentioning some of the new uses of electricity.

Rural electrification is one of the major fields of agricultural engineering and the Branch enjoyed Mr. Hemker's remarks on the subject. Our Branch has been particularly fortunate this year in having outstanding speakers discuss the several phases of our chosen profession.—*H. S. Glenn, Scribe*

VIRGINIA

DURING the first quarter of the school year, 1937-38, the Student Branch of the American Society of Agricultural Engineers at Virginia Polytechnic Institute held weekly meetings. At these meetings various topics were discussed that concern the agricultural engineer. These discussions were made by members of the Branch, with constructive criticism given by a faculty adviser or a member appointed by the Branch president.

At one meeting each month, the Research and Development Club, which is affiliated with this Student Branch, presented and discussed a problem in the research field that would be of interest to the agricultural engineer and might possibly be used by some member as his special problem when he becomes a senior.

Also during the quarter moving pictures were shown to the members of the Branch. The first was a picture showing the mining and metallurgy of copper. A second showing scenes of the Norris Dam was presented for the entertainment and instruction of the members.

Officers for this year are P. H. Fitzgerald, president; D. C. Timberlake, vice-president; J. H. Eddy, secretary-treasurer; and R. B. Davis, Scribe.—*R. B. Davis, Scribe.*

OHIO

THIS year's lunch stand, operated during Farmers Week at Ohio State University, surpassed any previous year's by $200. The gross receipts were $1,038, which left a net profit of $300, after expenses and $70 in taxes were deducted.

The above returns were possible after fifteen years of striving by the branch to provide a better and more efficient lunch stand. In doing this, it is the desire of the branch to add or replace at least one important article every year, so that we now set up a well equipped restaurant serving everything from chewing gum to complete meals.

This lunch stand has obtained a reputation which we try to maintain. Costs of field trips, sending representatives to ASAE meetings, and current expenses, are paid from the money earned.

The first two meetings of the quarter were spent in making plans for the lunch stand.

At the meeting of February 10, our general business session was followed by two reels of movies showing one make of combine at work under all conditions. Announcement was also made concerning an extensive lighting demonstration which is to be given in the near future by one of the electric companies.—*Ralph Patterson, publications committee.*

TEXAS

THE Texas A. & M. Student Branch of the ASAE held their first meeting October 5, and have held eight meetings since. There are 140 students enrolled this term for the 4-year course in agricultural engineering. Of this number, well over half are members of the Student Branch.

The department staff has been greatly enlarged this year. One full-time instructor, C. E. Peach of Mississippi and Iowa State, and two graduate assistants have been added to the faculty. A large amount of new equipment, which includes 10 new tractors, has been added to the machinery laboratory.

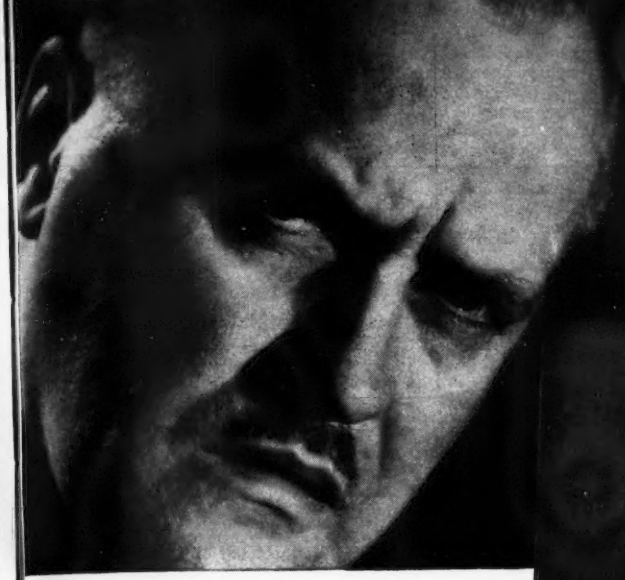
Several very interesting programs have been carried out during the year. The John Deere Plow Company and the Houston Branch of the International Harvester Company have each presented a program which included instructive talks by the branch managers and motion pictures of new farm equipment. The Student Branch film, "Agricultural Engineers of Tomorrow," was shown February 16. The film proved highly interesting to the large number present and we feel it is a valuable contribution to the activities of our Branch.

Arrangements for our big annual social event, "The Barnyard Frolic", given by the Agricultural Engineering students, are well under way. This is a very informal dance with costumes of every description being worn. The "Frolic" is held on the third floor of the machinery laboratory, which is decorated in barnyard style. Other activities for the coming spring will include the Smith-Hughes Vocational Agricultural Contests in Farm Shop and Soil Conservation, and the annual Senior inspection trip.—*Bob S. Smith.*

(News continued on page 136)

THE ASAE STUDENT BRANCH AT THE A. & M. COLLEGE OF TEXAS ASSEMBLED FOR ITS REGULAR MEETING ON DECEMBER 21, 1937

"You can't start any engine <u>that easy</u> on diesel fuel!"



● **Right you are—but the Waukesha-Hesselman low compression oil engine can run *safely* on gasoline. Spark ignition and gasoline priming make this *the easiest starting oil engine in the world!***

Tropical heat or sub-zero temperatures make no difference to a Hesselman—turn it over and it starts.

A primer atomizes and sprays a small charge of gasoline directly into the air intake manifold. Low pressures . . . no higher than in a gasoline engine . . . make cranking easy. And the spark plug makes ignition certain.

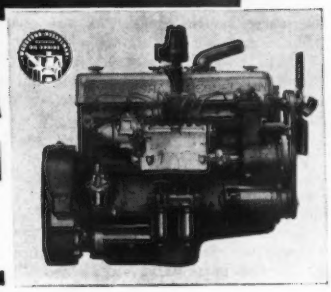
The Hesselman has only *one* main combustion chamber, and both gasoline and fuel oil are burned in it. *As soon as the engine fires, it begins to function on fuel oil.* No change-over mechanism is required—because the Hesselman always runs with spark ignition and low pressures.

A Hesselman burns low cost diesel fuels with a wider range of cetane ratings than any compression-ignition engine, and shows the *greatest overall economy.* Write for Bulletin 1011.

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN
NEW YORK • TULSA • LOS ANGELES

THIS IS NO. 2 OF A SERIES
ON THE WAUKESHA - HESSELMAN ENGINE

WAUKESHA HESSELMAN ENGINES...



Washington News Letter

from AMERICAN ENGINEERING COUNCIL

FEDERAL HOUSING ADMINISTRATION

HOUSING, in its several phases, is so much in the news from Washington, and is getting such attention from the Administration that Council feels obligated to keep member societies informed regarding major changes in the housing programs. The latest development has to do with construction of large housing projects as well as small residences, on which the Federal Housing Administration is prepared to guarantee the mortgages up to 80 per cent on the larger undertakings and as much as 90 per cent on residences which do not cost more than $6000.

Engineers interested in the promotion of better housing for the public or in the design, construction, and maintenance of housing properties may, therefore, find helpful factual information in the following excerpts from a summary of FHA releases to members of its own organization. In fact, the officials of the FHA feel that recent revisions in their laws make residential and apartment housing one of the more attractive forms of present day investment and they insist that it is going to be good business for those contractors who may cater to it.

In the language of the Senate Banking Currency Committee, it is intended "to utilize the best available means for achieving a sustained long term residential construction program with a minimum expenditure of federal funds and a maximum reliance upon private business enterprise."

It deals solely with projects and mortgages that are considered economically sound. It is designed to be largely self-sustaining through the operation of a federal mortgage insurance system which has been carefully established and successfully operated since 1934.

The Housing Administration is authorized to insure a total of $2,000,000,000 outstanding at any one time and with the approval of the President this amount may be increased to $3,000,000,000.

Notices have been sent to 7,000 lending institutions throughout the United States, authorizing them to begin making modernization and repair loans under Title I of the amended Act.

Persons, partnerships and corporations are eligible to borrow money under the modernization and repair credit plan. The borrower must have an assured income, demonstrate his ability to repay the loan, and own the property to be improved or have a lease on it running at least six months longer than the term of the loan.

Amounts up to $10,000 may be borrowed to repair or improve existing structures and amounts up to $2500 may be borrowed for the erection of new structures. Repayment of the loans may be spread over a period not to exceed five years for modernization and repair work and not to exceed ten years for the erection of new structures for residential use.

The provision for these new homes costing not in excess of $2500 under Title I should not be confused with the plan of home ownership sponsored under Title II of the Act. The facilities afforded under Title I are intended primarily for those citizens who live on farms, or in rural areas or in the marginal zone surrounding the larger cities where the standards established by the mutual mortgage insurance system are not applicable.

Specific information about how to proceed with the financing and construction of a home or with a housing enterprise which will provide residences for rent or for sale may be gotten by writing to The Federal Housing Administration, Washington, D. C., or from its Regional offices in the larger cities. They have a number of publications dealing with planning, financing, and building homes which are suggestive. One of the more interesting publications entitled "Rental Housing As Investment" deals in a most interesting way with the FHA concept of security of the investment.

Personals

B. A. Jennings is author of Cornell Extension Bulletin 381, on "Plow Adjustment."

Mack M. Jones is author of University of Missouri extension leaflet AEE-2, entitled "Electric Fences."

M. A. R. Kelley is senior author of USDA Technical Bulletin No. 591, on "Relation of Stable Environment to Milk Production."

Ralph R. Parks is author of a mimeographed extension leaflet of the University of Illinois, on the subject, "An Electric Fence."

L. J. Smith, H. N. Colby, and Harry L. Garver are joint authors of the thirteenth annual "Progress Report" of Investigations of the various uses of electricity for agriculture in the State of Washington.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the February issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Richard P. Askerman, Senior Foreman, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Chamberlain, S. Dak.

C. A. Cowan, Branch Manager, International Harvester Co., 201 Potrero Ave., San Francisco, Calif.

W. H. Dickerson, Jr., Assistant County Agent, Extension Division, Agricultural Engineering Department, Virginia Polytechnic Institute, Blacksburg, Va.

Henry G. Garrard, Jr., Trainee, sales department, J. I. Case Co., Indianapolis, Ind.

Philomon L. Gully, Assistant Agricultural Engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Laurel, Miss.

Alexander Hay, Agricultural Liaison Officer, The Rubber Growers' Association, Inc., 19 Fenchurch Street, London, E. C. 3.

Paul W. Hossler, Minor Engineering Aide, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 330 Elm Street, Coshocton, Ohio.

Alexander M. Smith, Assistant General Manager, The Lamson and Sessions Company, 6255 West 65th St., Chicago, Ill.

LeBaron Turner, President, U. S. Wind Engine & Pump Co., Batavia, Ill. (Mail) 113 Fulton Street, Geneva, Ill.

W. Eugene White, Assistant Extension Agricultural Engineer, Agricultural College, University of Nebraska, Lincoln, Nebr. (Mail) 2835 North 56th St.

TRANSFER OF GRADE

W. H. Carter, Assistant professor of agricultural engineering, Louisiana State University. University, La. (Transfer from Junior.)

R. R. Choate, Rural service engineer, Appalachian Electric Power Co., Roanoke, Va. (Transfer from Junior.)

Thayer Cleaver, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Agricultural Engineering Department, University of Illinois, Urbana, Ill. (Transfer from Junior.)

H. C. Fuller, Supervisor of Rural Development, Central New York Power Corp., Utica, New York. (Transfer from Junior.)

A. H. Glaves, Assistant Agricultural Engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Agricultural Engineering Department, Ives Hall, Ohio State University, Columbus, Ohio. (Transfer from Junior.)

Joseph L. Green, Designing Engineer, John Deere Harvester Works, East Moline, Ill. (Mail) 1215 15th St., Moline, Ill. (Transfer from Junior to Member.)

R. G. Harvey, Rural Service Manager, Central New York Power Corp., Syracuse, N. Y. (Mail) 210 Buckingham Ave. (Transfer from Associate.)

M. A. Jones, Assistant Extension agricultural engineer, Alabama Polytechnic Institute. (Mail) Athens, Alabama. (Transfer from Junior.)

Lamar M. Kishlar, Manager of Research, Ralston Purina Company, St. Louis, Mo. (Transfer Member to Fellow.)

Harry Loenhardt, Assistant agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Vega, Texas. (Transfer from Junior.)

Henry N. Luebcke, Assistant engineering aide, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Bowling Green, Ohio. (Transfer from Junior to Member.)

Max Meisels, Junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Camp SCS-NM-18, Buckhorn, N. Mex. (Transfer from Junior to Member.)

I. F. Reed, Assistant agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Box 792, Auburn, Ala. (Transfer from Junior to Member.)

Herbert S. Riesbol, Associate hydraulic engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 1515 Walnut St., Coshocton, Ohio. (Transfer from Junior to Member.)

Daniel E. Salsbery, Senior Engineering Aide, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 1600 Garfield, Laramie, Wyo. (Transfer from Junior to Member.)

Leonard G. Schoenleber, Assistant agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture, Washington, D. C. (Transfer from Junior to Member.)

CONSERVES THE MACHINES

The Parsons "Whirlwind" in action showing how soil is pulverized and deposited.

Typical conservation project where the U. S. government and local farmers cooperate in terracing operations.

...THAT CONSERVE THE LAND

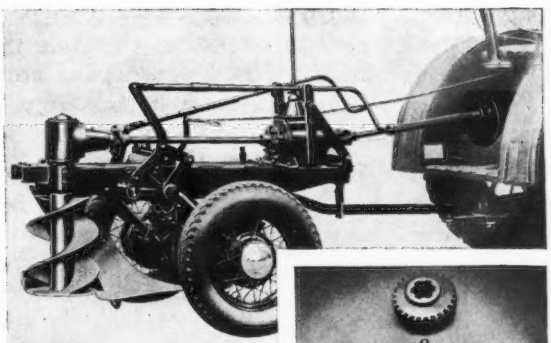
Parsons Terracing Machine Equipped with Parts of Enduring Nickel Alloy Steel

PICTURED ABOVE is a government soil conservation project showing the terracing technique now being used to prevent erosion.

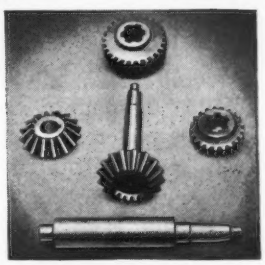
Inset shows the novel machine which has recently been developed for this purpose. Produced by the Parsons Company of Newton, Iowa, and called the "Whirlwind", it plows, elevates and discharges the earth in a continuous jet. Operated by tractor power, it builds up wide barriers, preventing the rich top soil from washing away. Obviously this machine must be light in weight yet capable of withstanding the heavy shocks and stresses encountered in these operations.

Earlier models had considerable difficulty with breakage of important gears, but the Parsons Company eliminated the difficulty by adopting Nickel alloy steels.

The superior toughness and strength of the Nickel steels is reflected in unusually high resistance to shock, stress, fatigue and wear. Consultation on their use in agricultural equipment of every type is invited.



Close-up view of terracer, showing draw-bar attachment and power connection with tractor's take-off.



Double spur gear, bevel gear, rotor shaft and gear integral, transmission spur gear and transmission shaft, all made of Nickel alloy steel and now used on Parsons "Whirlwind".

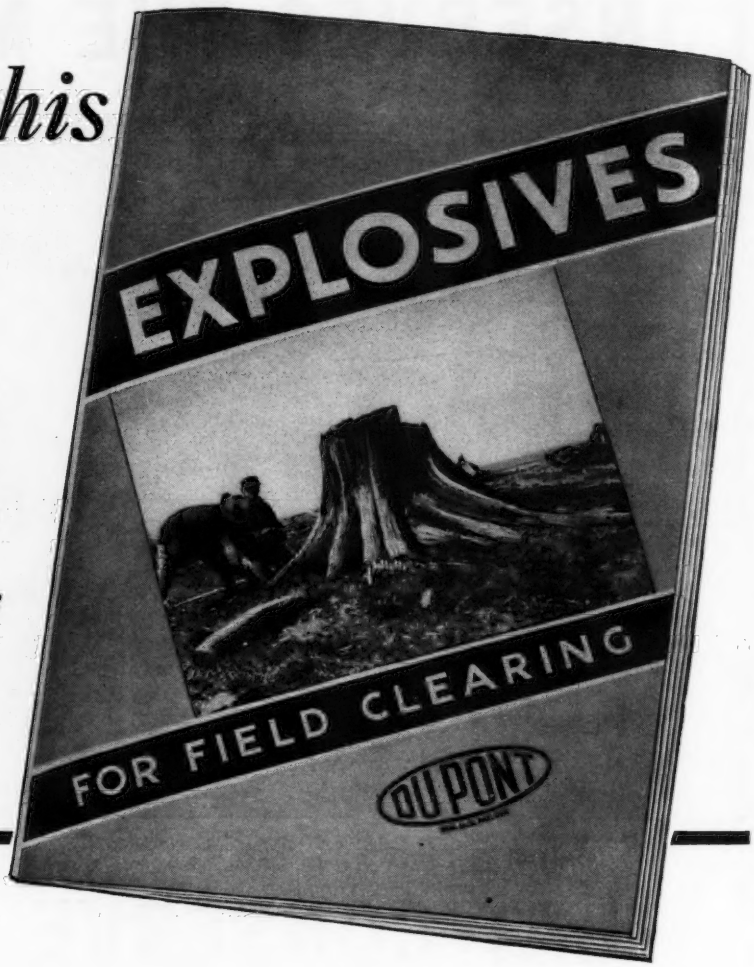
NICKEL
ALLOY STEELS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

Send for this

NEW BOOK

Explains how the use of explosives helps you to increase farm efficiency . . .



IN EVERY SECTION of the country, agricultural explosives are helping farmers get more production from their farms—and at lower costs.

More and more farmers and farm leaders are turning to the uses of dynamite, because it is a tremendous factor in promoting farm efficiency. The scattered stumps and imbedded boulders are quickly removed with dynamite's aid.

Dynamite clears fields of stumps and boulders, makes pasture land suitable for profitable farming. Blasting the ground before planting fruit trees promotes faster growth and earlier yields.

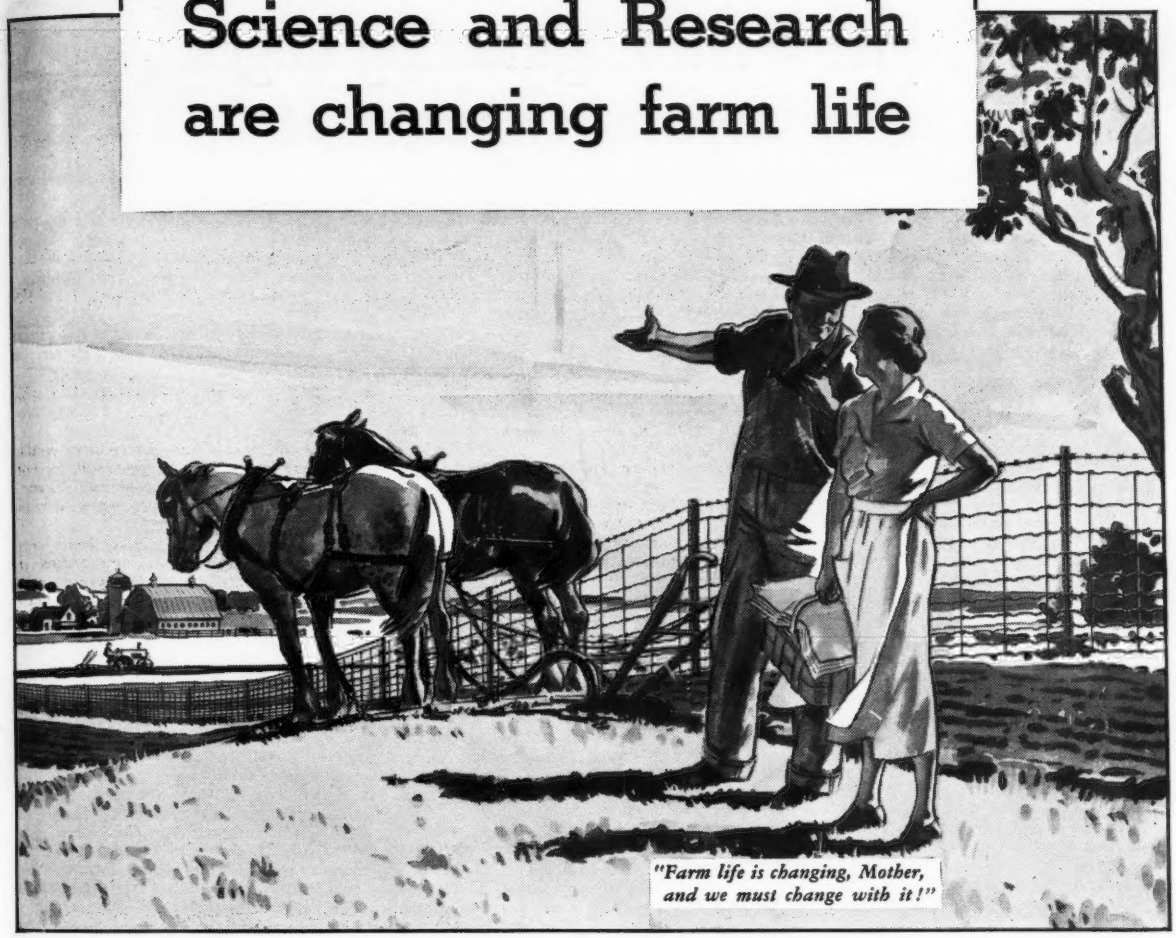
To help you spread the knowledge of modern methods in the use of agricultural explosives in your community, Du Pont has prepared this valuable book, "Explosives for Field Clearing."

Send for it today! It's absolutely free—as are other DU PONT aids for promoting greater farm efficiency. Address inquiries to

E. I. du Pont de Nemours & Co., Inc.
Explosives Department
Agricultural Extension Section
WILMINGTON, DELAWARE

DU PONT REG. U. S. PAT. OFF. **AGRICULTURAL EXPLOSIVES**

Science and Research are changing farm life



"Farm life is changing, Mother, and we must change with it!"

Republic Foresees Still Greater Progress on the Farm

LIKE the dawning of a new day, have come the modern tractor, the latest combine, the corn picker, power washer, automobile and radio. But Republic foresees still greater progress. And with that in mind, it is carrying forward many important agricultural research and educational activities.

One of these is its new Agricultural Extension Bureau, under the able direction of an agricultural engineer. Another is its Research Fellowship at Iowa State College, Ames, Iowa. A third is its new all-sound motion picture, "Steel, Servant of the Soil". And a fourth is its new "Fence Handbook", a comprehensive and authoritative work by Professor Henry Giese of the agricultural department of Iowa State College.

In this same forward-looking spirit, Republic metallurgists and engineers are constantly working with leading manufacturers of farm implements and machinery — helping to make their products cost less, look better, last longer, and serve better and more economically.

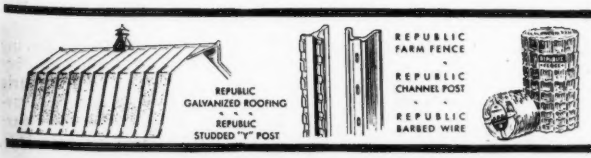
Finally, Republic's pioneering spirit is finding practical expression through extensive new facilities, which it is today devoting to the development and production of an outstanding line of fence, barbed wire, steel posts, galvanized roofing and other products for the farm.

Because of these and other forward-looking activities, the farmers of America are coming to expect from Republic all that is newest and best in the realm of steel.

Republic Steel Corporation
(WIRE DIVISION)
7850 South Chicago Ave. Chicago, Illinois
(General Offices: Cleveland, Ohio)

Farm Products Plants at: GADSDEN, ALABAMA, and CHICAGO

CULFSTEEL REPUBLIC STEEL



How well do you know your local dealer?

Your Republic dealer is interested in you. You should be interested in him—for each of you helps the other. Plan to get better acquainted.

Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, principal agricultural engineer, Office of Experiment Stations, U. S. Department of Agriculture.

A STUDY OF INFLUENCE OF DEPTH OF GROUND-WATER LEVEL ON YIELDS OF CROPS GROWN ON PEAT LANDS, *H. B. Roe.* Minnesota Sta. Bul. 330 (1936), pp. 32, figs. 9. Investigations are reported which were begun in 1925 and extended through the summer of 1930 to determine the degree of drainage that produced the best practical results with field and horticultural crops commonly grown in Minnesota on peat lands.

As drainage is a prime requisite in the agricultural use of peat soils, in this experiment depths of water table 1, 2, 3, 4, and 5 ft below the surface were secured on definitely limited areas. Control of the depth of water table on each control plat was secured by an adjustable weir in the main tile line downstream from the plat, the water being fed into the soil by a loop of 4 or 5-in drain tile surrounding the control plat, taking off from and ending in the main above the weir. Depth of water table was measured semiweekly throughout each season from the tops of test wells set in straight lines across each control area at intervals. Elevation of tops of test wells was redetermined several times each season. The data obtained showed control of the ground-water level by this method to be possible within practical limits at any desired depth below the surface, provided the peat is at least as deep as the desired water level, if there is an ample supply of underground water, and if potential settlement of the original bog surface is allowed for in the control works. Control, however, is relatively expensive and can be justified only in the case of special crops yielding a high return per acre.

Settling of the surface of the bog continued for several seasons after cultivation began. It was practically proportional to the depth of water table maintained on the different plats. One may expect a total settlement of from 6 in to 2 ft. Such surface settlement is one of the principal factors determining proper depth of drains in a new bog if the depth of the peat is 4 ft or more. Over any given control area the surface of the water table tended to remain flat; but heavy rainfall caused temporary upward arching of it between tile lines, while high water requirement by the plants during July and August depressed it.

The surface was packed with a heavy roller each season before seeding or planting. The packing is essential for satisfactory seed germination. It seems also to aid in protection against summer frosts owing to better heat conductivity of the compacted peat. Fertilizer was applied by the cooperating divisions as follows: 1925, over the entire tract, triple superphosphate at the rate of 400 lb and muriate of potash at the rate of 200 lb per acre; other years, for field crops nothing and for truck crops 16 per cent superphosphate at the rate of 600 lb and muriate of potash at the rate of 400 lb per acre. For best results, careful attention to the use of fertilizer is essential on peat soils. No general rule can be given. Each bog is an individual problem.

Crops raised were as follows: Field crops—sugar beets, field corn, flax, oats, soybean hay, and timothy and clover hay; truck crops—snap beans, sweet corn, onions, potatoes, tomatoes, carrots, summer radish, winter radish, cabbage, cauliflower, spinach, lettuce, and celery.

Summer frosts occurred nearly every summer. They seriously affected yields of those crops especially susceptible to damage by frost, notably flax, field corn, beans, sweet corn, potatoes, and tomatoes. Soybeans, usually fairly resistant to frost, were seriously damaged by both June and August frost. Frost damage was greater on the deeper controls owing to the poor heat conductance of the peat soil, indicating that as high a ground-water level as compatible with the crops to be raised is desirable as one means of protection against the summer frost menace.

Air drainage was poor especially when the wind was from a direction west of north, owing to the presence of a solid wall of timber and brush along the south and east sides of the experimental tract. That a lack of good air drainage emphasizes the frost menace is evident from the fact that after the timber on the east and south was removed, permitting free air movement over the entire region, summer frosts rarely occurred. Yields were determined for each half foot difference in ground-water level.

Flax did fairly well the first season with best results at from 3 to 3½-ft depth of ground water. It was a failure all other seasons, due largely to weed infestation, although also damaged by summer frosts which are a serious handicap with flax on peat. However, elsewhere in Minnesota, good success has been obtained with flax on peat as the first crop in any breaking. After the first crop the weed nuisance is usually difficult to overcome. Once it is overcome, good success may be had with flax even after the first year.

Oats was not a satisfactory crop any season at any depth of drainage, which is contrary to usual experience with oats on peat except where lodging or severe rust occurs.

Hay crops, such as soybeans, timothy, and clover, did well, with best yields where drainage was not over 2½ ft deep after the bog had ceased to settle.

Spinach and head lettuce failed to give any satisfactory results. Failure of spinach, usually a reliable crop on peat soil, is not readily accounted for unless due to unseasonable planting. Climatic conditions in this region are not favorable for production of head lettuce.

After settling of the bog was complete, best results were generally obtained for all other crops in these tests with depths of water table from 3 to 3½ ft. On peat soils a final average depth of drainage from 3 to 3½ ft, after settlement of the bog is practically complete, is recommended where growing of almost any type of crop is apt to be tried at some time.

A SEED DROPPER FOR CEREAL NURSERY ROWS, *L. C. Burnett.* Jour. Amer. Soc. Agron., 29 (1937), No. 5, pp. 419, 420, fig. 1. In a brief contribution from the Iowa Experiment Station a seed dropper is described and illustrated which was adapted from a chain-drive model.

INVESTIGATIONS ON MACHINERY USED IN SPRAYING. III, THE OUTPUT AND RANGE OF NOZZLES AND GUNS, *C. Davis* and *G. R. B. Smith-Homewood.* Jour. Southeast. Agr. Col., Wye. Kent. No. 39 (1937), pp. 61-72. This is the third report of these experiments which, in essence, indicate that those factors which control nozzle output and range also control the output and carry of spray guns. The range is greater and the number of gallons ejected per minute is larger the greater the pump pressure, the larger the disk aperture, and the narrower the cone of spray.

The results indicate that the spray gun is superior to all other spray tools for large and medium-sized trees.

BLUEBERRY TILLAGE PROBLEMS AND A NEW HARROW, *C. A. Doehlert.* New Jersey Stas. Bul. 625 (1937), pp. 12, figs. 4. The object of the investigation covered by this report was the development of a practical cultivating tool for blueberries.

In the experimental work clean cultivation was found successful as a factor in maintaining large blueberry yields, the benefits being attributed mainly to weed control. Tillage close to the plant by means of ordinary cultivators was found impractical after the first two years because of the low spread of the branches of the bushes. The spread of the tops also indicated the need for a tool of light draft. Root pruning by deep cultivation checked the development of the plants, whereas shallow cultivation was found to conserve the organic matter in the soil. The practice of mounding also presented the need for a tool which is automatically adjustable to varying combinations of sloping and flat surfaces.

A new harrow was developed which meets these requirements. This development is described and illustrated.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE OHIO STATION, *G. W. McCuen, C. O. Reed, R. C. Miller, V. L. Overholt, I. P. Blauser, G. H. Stringfield, E. A. Silver, C. W. Ellenwood, P. Gerlaugh, C. H. Kick, and A. J. Schalk.* Ohio Sta. Bul. 579 (1937), pp. 108-117, figs. 6. The progress results are briefly presented of investigations on farm operating efficiency, the use of electricity for soil sterilization and heating for tomato improvement, mechanical equipment for the planting of irregularly shaped kernels of hybrid corn, crop storage, fruit washing, mechanical processing of cattle feed, and the combine harvester-thresher.

(Continued on page 142)

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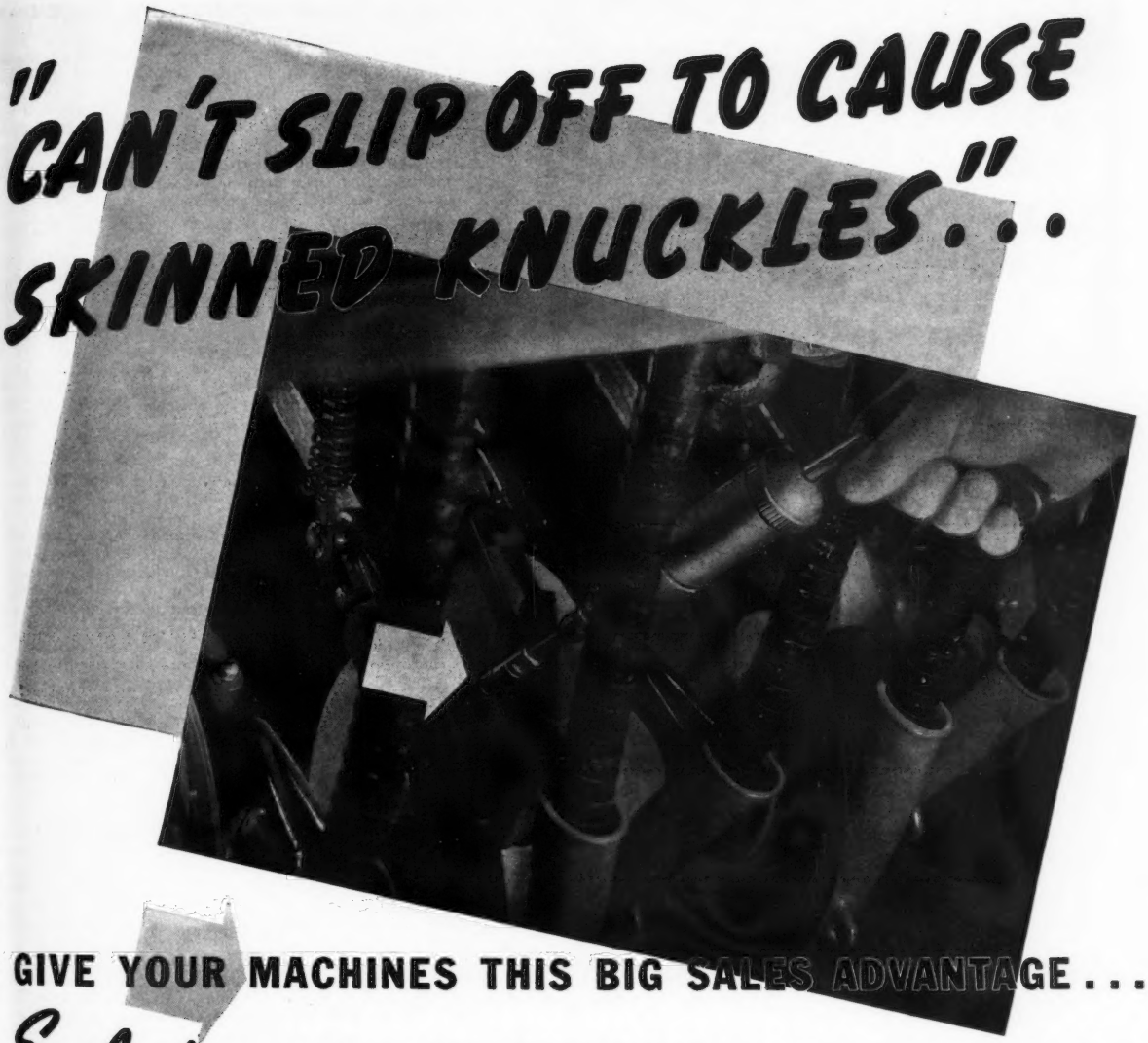

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(Continued from page 140)

USE OF IRRIGATION WATER ON FARM CROPS, *A. E. Palmer.* Canada Dept. Agr. Pub. 509 (1936), pp. 51, figs. 7. The results of a large number of experiments are reported which were conducted at the Dominion Experimental Station at Lethbridge, Alta. These were planned to determine the stage of plant growth when water should be applied to field crops, the value of fall irrigation, and the number of irrigations required in different years by various crops. Data are reported from experiments on the irrigation of wheat, alfalfa, potatoes, sugar beets, and sunflowers, covering a period of from 2 to 6 yr.

One irrigation produced a good crop of wheat in the years of average rainfall. In the drier seasons, two applications of water were needed. Irrigating in the fall after harvest for the succeeding year's wheat crop proved to be a good practice. If a fall irrigation was not given, and if the precipitation of May and early June was not abnormally high, it was found essential to irrigate after the crop was up in the spring but before the plants were checked in growth by lack of moisture. Contrary to the usual opinion, irrigating wheat as early as the three-leaf stage did not reduce yields on the sandy clay-loam soils where the experiments were conducted. When wheat needed more than one irrigation, good results were obtained when the second application was made in the flowering stage. Irrigating wheat in the soft-dough stage did not increase yields, but sometimes caused the grain to lodge.

In each year of the experiments, except the wet year of 1927, alfalfa required at least two irrigations to produce two good crops. It was found necessary to apply one of these the previous fall or in early May to give a heavy first cutting of hay. A second irrigation was required just before or just after cutting the first crop. If May was dry, an irrigation when the first crop was about 12 in high increased the yields. It seemed to make little difference in the yields of the second crop whether the water was applied 10 days before or immediately after cutting the first crop.

Irish cobbler potatoes, irrigated when the plants were half-grown, gave lower yields than were secured if the first irrigation was postponed until the plants were starting to bloom. In the drier seasons an irrigation in the starting-bloom stage and two subsequent irrigations at intervals of 20 days was the most satisfactory practice. There was no consistent difference observable in the cooking quality of potatoes receiving different irrigation treatments. When the plants were retarded in growth from lack of water and then irrigated, second growths, resulting in knotty tubers, were prevalent. The potatoes receiving five or six irrigations produced tubers with enlarged lenticels, but the cooking quality did not appear to be impaired. The greater number of irrigations produced more small potatoes than one or two irrigations.

Sugar beets have given the best yields and have had the highest sugar content when the soil has been kept moist enough for maximum growth during the entire growing season. In dry years this has required irrigating as often as every 2 weeks from the first or second week of July to early September on loam soils.

Sunflowers gave best yields on fall-irrigated land, or with a spring irrigation when the plants were about 6 in high. In the 2 yr of the test with sunflowers one irrigation in the season was sufficient. This crop wilted noticeably if the soil became too dry, but revived and produced fair yields when water was applied.

These experiments indicate that, including the available water in the soil at the beginning of the season, wheat requires from 1½ to 1¾ acre-ft of water, alfalfa from 1¾ to 2¼, and potatoes about 1½ acre-ft to produce good crops.

Soil moisture determinations made of each foot-depth of soil to a depth of 6 ft before and after each irrigation showed that a 6-in application of water failed to penetrate into the soil to a depth of 6 ft in more than half the plats when the soil moisture content was below 11 per cent at the time of irrigation. With a moisture content between 11 and 13 per cent, from 60 to 70 per cent of the observations showed that the water had penetrated to 6 ft. The water applied to almost all of the plats having a soil moisture content above 13 per cent wet down 6 ft or more.

The loss of water from the soil of fall-irrigated land between the time of irrigating in the fall and seeding the following spring was noticeable but usually not important, except in 1925-26, when the weather between mid-October and early May was very open, dry, and windy. During that period the water loss from a number of plats was about equal to the irrigation application of the previous fall.

IMPROVING THE FARM WAGON, *W. P. Kintzley and D. P. Craig.* Colorado Sta. Bul. 434 (1937), pp. 7, figs. 5. A method of low-cost improvement of the horse-drawn wagon for general farm use is briefly described, with explanation of the simple construction necessary. *(Continued on page 144)*

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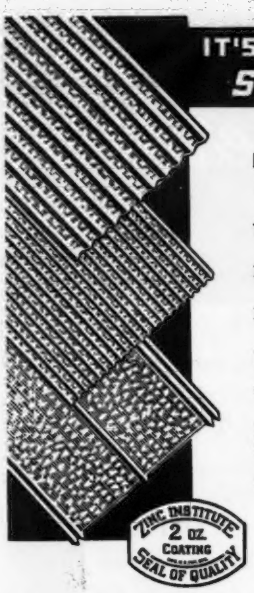

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(Continued from page 142)

SOIL AND WATER CONSERVATION IN THE PACIFIC NORTHWEST, *E. M. Rowalt.* U. S. Dept. Agr., Farmers' Bul. 1773 (1937), pp. IV + 59, figs. 31. This bulletin deals with erosion of the soil by wind and water and with measures recommended and employed by the Soil Conservation Service for the control of erosion on the farms and ranges of the Pacific Northwest. It treats particularly of wheat lands and grazing lands.

Since soil conservation is inseparable from water conservation, certain sections of the bulletin deal specifically with the conservation of water for the production of crops on nonirrigated land and the conservation of water for irrigation purposes and for flood prevention. Another section deals with the control of drifting dune sands along the coastal beaches of Oregon and Washington.

CONSTRUCTION OF FARM BUILDINGS: THE USE OF SUN-DRIED BRICK, *H. W. Lane.* East African Agr. Jour., 2 (1937), No. 5, pp. 381-383. This is a brief presentation of information on the use of rammed and sun-dried earth for the construction of farm buildings in Kenya Colony.

DAIRY BARN WITH SEPARATE MILKING ROOM, *C. E. Wylie and S. A. Hinton.* Tenn. Univ. Mimeogr. Rpt. 24 (1937), pp. 4, pls. 2. This is a brief description of the new dairy barn at the University of Tennessee with its essential accessories.

MODERN EQUIPMENT FOR THE POULTRY FARM, *A. Hay and D. F. C. Vosper.* Rubber Growers' Assoc., Rubber and Agr. Ser. Bul. 7 (1937), pp. [1] + 14, figs. 17. The essential purpose of this publication is to illustrate the use of rubber on the various types of equipment used around the modern poultry farm in England.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE MASSACHUSETTS STATION, *C. I. Gunness et al.* Massachusetts Sta. Bul. 339 (1937), p. 8. Progress results are briefly presented of investigations on low-lift pumps for cranberry bogs, milk cooling, cranberry storage, brooder development, and apple storages.

SNOW SURVEYS FOR THE PURPOSE OF FORECASTING STREAM FLOW, *R. C. Farrow.* Forestry Chron., 13 (1937), No. 1, pp. 271-283, pl. 1, figs. 5. The degree of success attained in snow surveys in southern British Columbia as a means of forecasting water supply for irrigation, power, and other purposes is reported upon in this article. Conditions which militate against the accuracy and reliability of the forecasts are also discussed.

USE OF ARTIFICIAL LIGHT FOR POULTRY, *C. S. Platt.* New Jersey Stas. Hints to Poultrymen, 24 (1937), No. 4, pp. 4. The stimulating effect of light on egg production is discussed, and suggestions are offered as to when to use artificial light and how to feed the flock receiving it.

EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

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